

TECHNOLOGY DEPT.

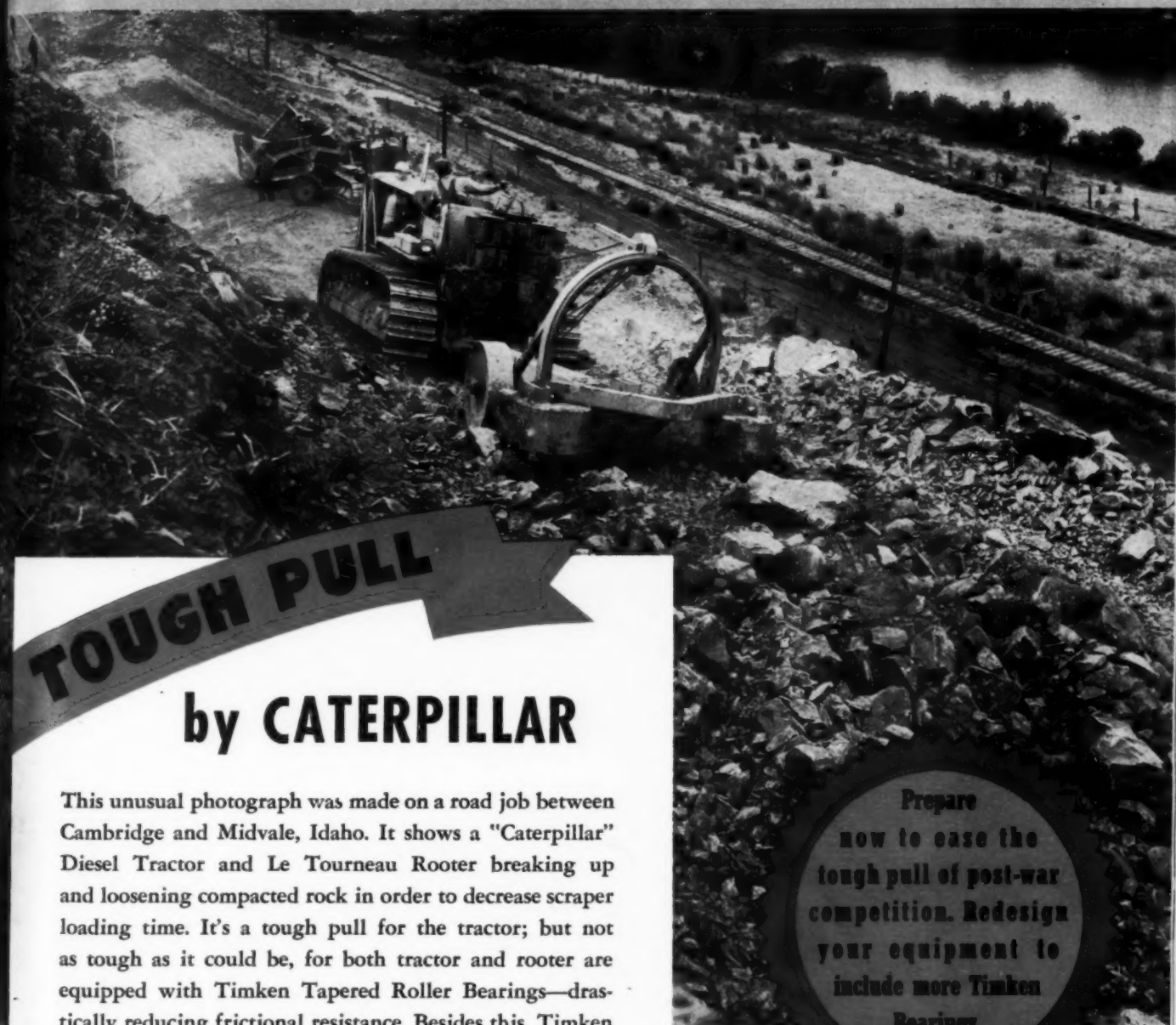
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DETROIT

# ROADS AND STREETS

DECEMBER 1943



**TOUGH PULL**

**by CATERPILLAR**

This unusual photograph was made on a road job between Cambridge and Midvale, Idaho. It shows a "Caterpillar" Diesel Tractor and Le Tourneau Rooter breaking up and loosening compacted rock in order to decrease scraper loading time. It's a tough pull for the tractor; but not as tough as it could be, for both tractor and rooter are equipped with Timken Tapered Roller Bearings—drastically reducing frictional resistance. Besides this, Timken Bearings increase endurance and cut maintenance by their ability to carry radial, thrust and combined loads; and to hold moving parts in correct and constant alignment. These qualities are helping to give superior performance to American war machines of every kind. The Timken Roller Bearing Company, Canton, Ohio.


Prepare  
now to ease the  
tough pull of post-war  
competition. Redesign  
your equipment to  
include more Timken  
Bearings.

**TIMKEN**  
TRADE-MARK REG. U. S. PAT. OFF.  
**TAPERED ROLLER BEARINGS**

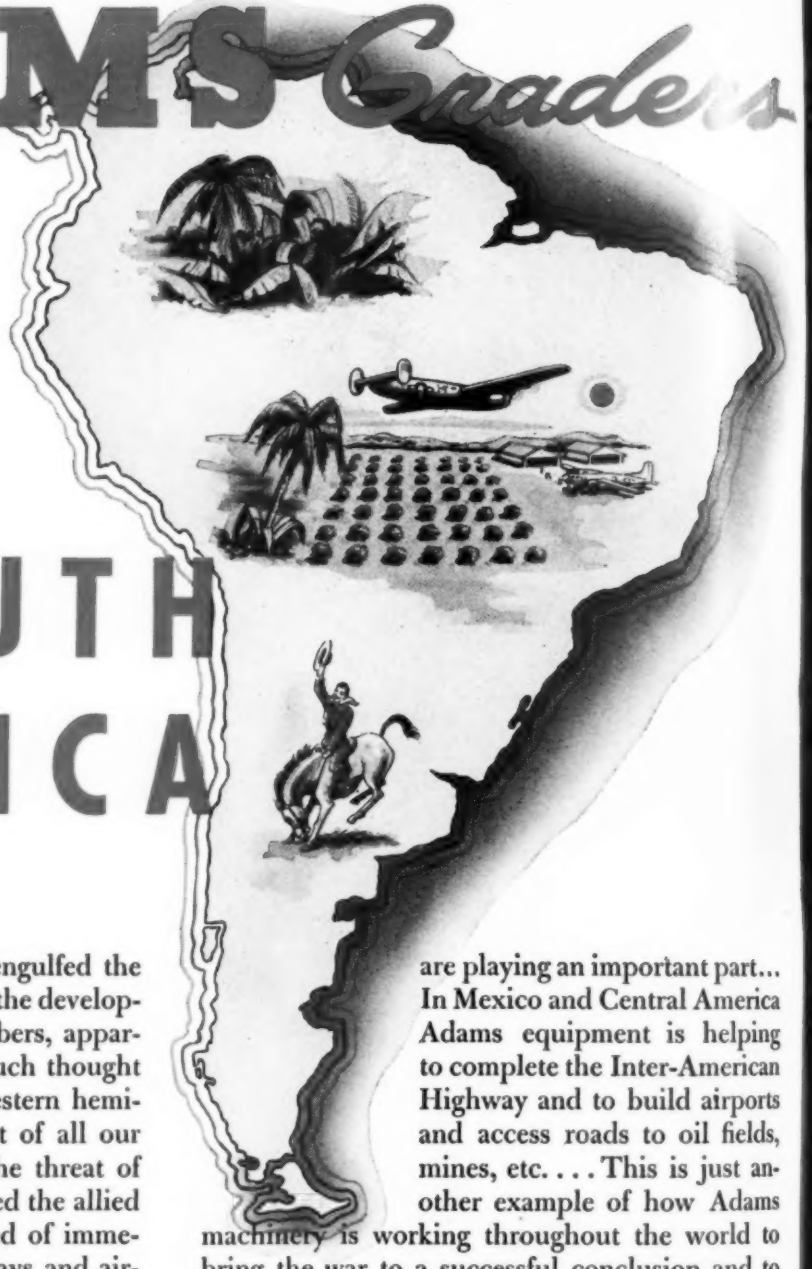
# ADAMS Graders

Work for the  
Defense of the  
Western  
Hemisphere

## IN SOUTH AMERICA



UNTIL the present war engulfed the world and brought about the development of long range bombers, apparently no one gave too much thought to the invasion of the western hemisphere by a European power—least of all our neighbors to the south. Last year the threat of such an invasion from Africa awakened the allied nations in South America to the need of immediate development of military highways and airports, so, scores of Adams machines already on the continent were put to work on such projects . . . Not only did these military necessities loom up but closer economic collaboration with these countries has resulted in the greater development of roads and airports for the procurement of natural resources including much needed rubber and quartz. In these developments Adams graders



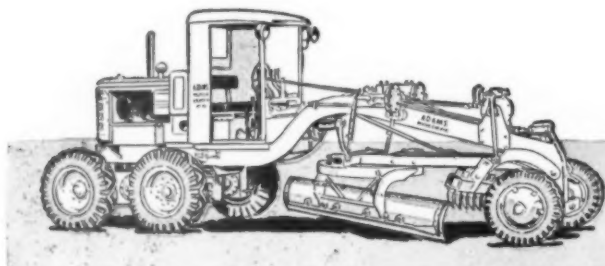
are playing an important part... In Mexico and Central America Adams equipment is helping to complete the Inter-American Highway and to build airports and access roads to oil fields, mines, etc. . . . This is just another example of how Adams machinery is working throughout the world to bring the war to a successful conclusion and to build for a better world of peace . . . When peace comes you will do well to look to Adams for the new machines you will need to follow your peaceful pursuits.

J. D. ADAMS COMPANY, INDIANAPOLIS, INDIANA  
*Sales and Service Throughout the World*

## Adams

ROAD BUILDING • EARTH MOVING EQUIPMENT

Motor Graders • Leaning Wheel Graders  
Elevating Graders • Hauling Scrapers • Etc.



Once a  
machine



# The women

They know that this is war, and that the price of victory will be high. They have sent off their sons, brothers and husbands to the armed forces, and they are coming out of beauty shops and offices, stores and homes, and are taking war jobs in steel mills and shipyards. The deft hands that in peacetime wielded the skillet and the dryer are now managing the boring mill and the welding torch—and to very good effect.

Ever try keeping traffic flowing smoothly in and out of the main entrance of a big steel plant? Ever knock a "hot top" off an ingot? Or rough-bore a gun forging? Or weld a ship's hull? Not women's work? Women are every day doing these and dozens of other jobs in Bethlehem shipyards and steel plants, and doing them superbly.

At Bethlehem and Lackawanna, at Baltimore, at Fore River and Hingham, on the Pacific Coast—and at other locations where this company operates plants and shipyards—former clerks and beauty-shop operators, salesgirls and housewives, are applying themselves to their new, challenging tasks with wonderful spirit and skill. They are helping to swell the mighty output of steel and ships and ordnance. The results of their efforts are being painfully felt in Tokyo and Berlin. Hats off to them!



Woman "patrolman" at a Bethlehem steel plant. Here is a job calling for plenty of tact and skill! Women are serving on patrol duty at gates, parking lots, offices, and other locations with efficiency and aplomb.



Once a dancer, now she runs a machine in a Bethlehem shipyard.

This "buggy" operator is hauling naval shells in a Bethlehem plant.

Upswept hairdo, red finger-nails, don't keep this girl welder from doing a man-size job at a Bethlehem shipyard.

# ROADS AND STREETS

Vol. 86, No. 12

December, 1943



*A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations; and to the construction and maintenance of airports.*

WITH ROADS AND STREETS HAVE BEEN COMBINED GOOD  
ROADS MAGAZINE AND ENGINEERING & CONTRACTING

## CONTENTS

Long Concrete and Steel Bridge Raised 10 Feet with Gantry and Jacks.....	41
By C. D. Haxby, General Superintendent, The Rust Engineering Co., Pittsburgh, Pa.	
More About Air Entraining Cement.....	45
Tractor Trains at 70° Below.....	48
By Harold J. McKeever Editor, Roads and Streets	
Assembly and Operation of Plate Bearing Test Equipment.....	50
By H. K. Glidden, Chief Airways Engineering Branch, First Region Civil Aeronautics Administration, La Guardia Field, New York	
Highways and Bridges of El Salvador.....	53
By John C. Black Editor, Caminos y Calles	
Federal-Aid and Its Relationship with the States.....	57
By John U. Schroyer, Secretary of Highways Pennsylvania Department of Highways, Harrisburg, Pa.	
Cost Finding on Street Repairs.....	62
By John H. Marvin, Supt. of Public Works Record Cincinnati, Ohio	
The Recent Highway Meetings in Chicago.....	65
Arch Forms Detailed for Quick Handling.....	71
Editorial.....	72
Construction Equipment Maintenance.....	73
Real Monthly Equipment Check-Up.....	75
"All Out" Equipment Distributor.....	78
How to Keep Your Excavator Going.....	81
Each Operator a Maintenance Man.....	84
New Equipment and Materials.....	86
Coronach.....	88
With the Manufacturers.....	90
Meetings Ahead.....	90
New Trade Literature.....	93

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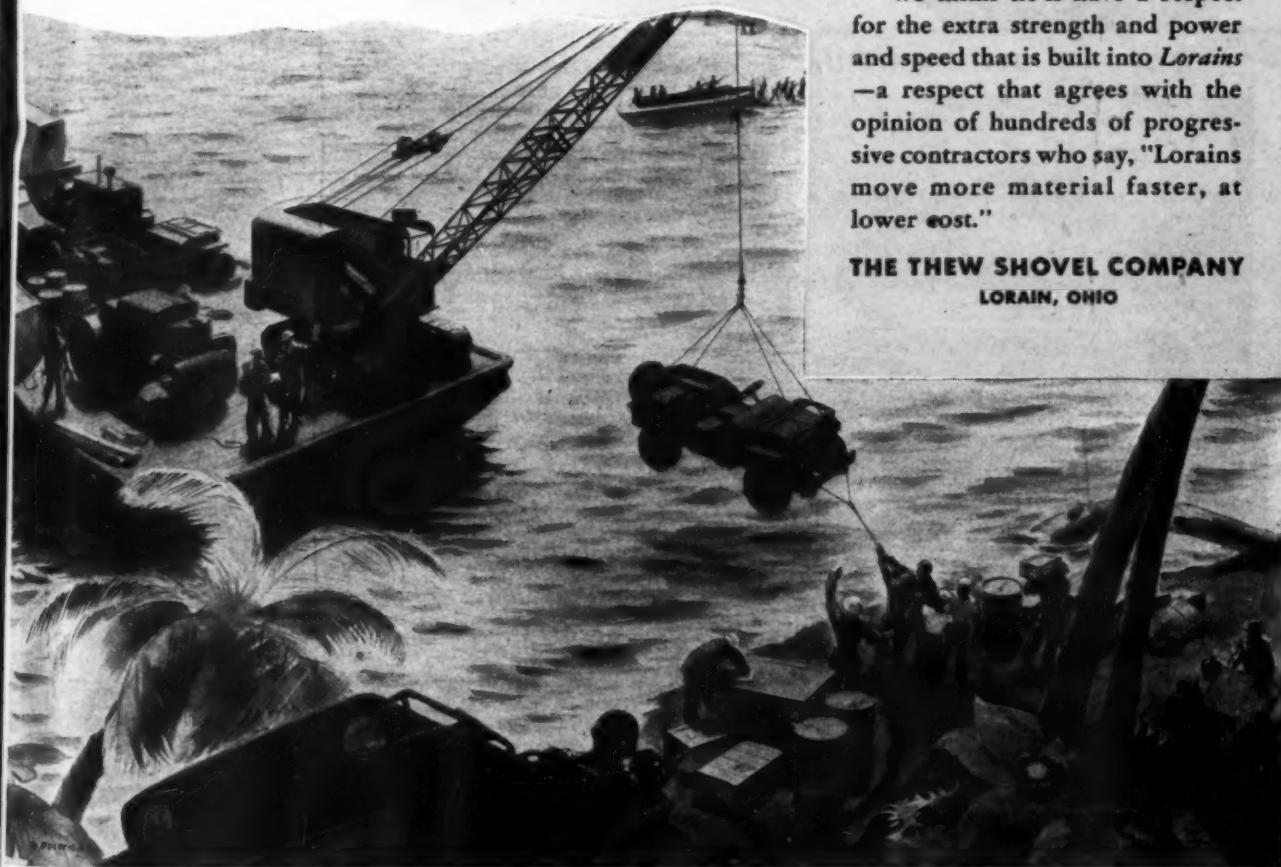
# When the Seabee Comes Home

Some day he will be back...full of experiences to make your hair stand on end and rarin' to go to work in a peacetime world. He may have run a tractor, a bulldozer, a shovel or crane. Probably he has helped to build bridges, ditches, airfields and roads.

Chances are that somewhere along the way he's learned how a *Lorain* performs. He's seen them in action or he's worked them himself—unloading supplies and heavy equipment, moving dirt by the ton, digging ditches, preparing gun emplacements—all under conditions that are tougher than you'll ever meet.

We think he'll have a respect for the extra strength and power and speed that is built into *Lorains*—a respect that agrees with the opinion of hundreds of progressive contractors who say, "Lorains move more material faster, at lower cost."

**THE THEW SHOVEL COMPANY**  
LORAIN, OHIO



thew-**Lorain**

**CRANES**

**SHOVELS • DRAGLINES • MOTO-CRANES**



# Speed Drilling. Reduce Costs with Regular Lubrication

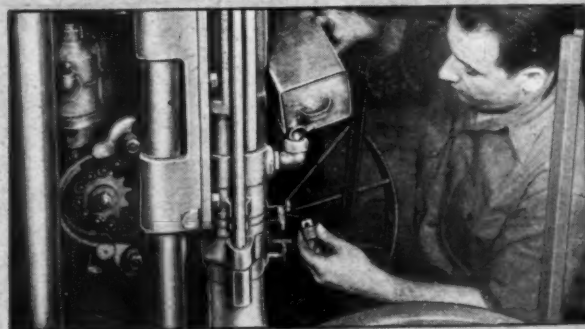


Although rugged and powerful . . . designed for heavy duty, high speed, deep-hole drilling . . . CP G-200 Wagon Drills are easily and quickly operated by one man. They need but little maintenance care — but they do need that little! Keep them tight and lubricate them regularly.

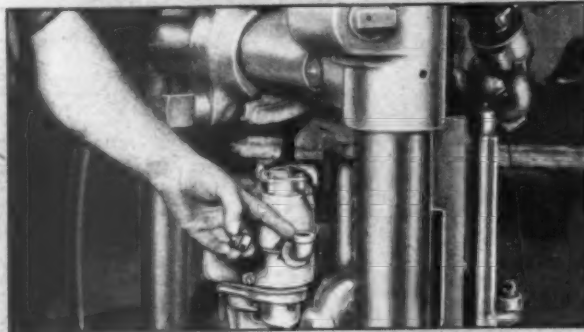
## HOW TO GET MAXIMUM SERVICE FROM YOUR WAGON DRILL



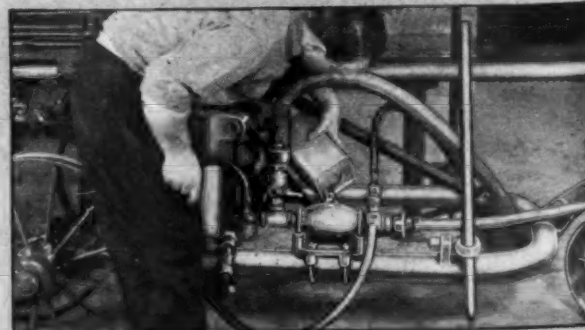
**1** Put about four ounces of fairly heavy oil in the gooseneck and blow through before starting work.



**2** Fill rock drill oil reservoir with half a pint of right grade of rock drill oil before every shift.



**3** Check gear case frequently, keep filled to plug level. Should have regular attention once a week.



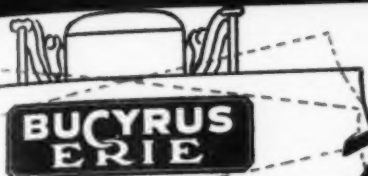
**4** Always fill the line oiler twice each day when wagon drill is in operation. Capacity, one pint.

★★★★★★★  
PNEUMATIC TOOLS  
ELECTRIC TOOLS  
(Nicycle...Universal)  
ROCK DRILLS

CHICAGO PNEUMATIC  
TOOL  COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★  
AIR COMPRESSORS  
VACUUM PUMPS  
DIESEL ENGINES  
AVIATION ACCESSORIES



Make the

**TILT**

Work for **YOU**

man can tilt or angle the blade on a Bucyrus-Erie grader in just a few minutes time without assistance. That's why it's so easy to take advantage of blade tilt to do your work in the fastest most efficient way possible. Here's how you can tilt:

**1** WHEN TRACKS MUST TRAVEL ON A SLOPE AND YOU WANT TO ESTABLISH A LEVEL CUT: Tilt in with the advance corner low, which starts a leveling cut and throws the material out along the angled blade, over-casting the excavated material. As tracks move onto the section you have notched into the bank and filled on the slope, continue with the tilted blade only long enough to get tracks on the desired grade level. Then adjust back to a level blade but continue to lead with the inside corner in order to plow the material out to fill on the side slope.



**2** WHEN TRACKS MUST TRAVEL ON THE LEVEL AND YOU WANT TO ESTABLISH A SLOPING CUT: With front corner tilted down, take a cut along the center-line of your ditch until you have a track length. Then level the blade and, working your tractor on the slanted bank, continue to angle your material up the slope and into your spoil pile. If you are opening a V-ditch, repeat on the opposite side at proper slope to make the desired cut.



**3** PEELING (OR SLOPING DOWN) VERTICAL OR STEEP BANK: Tilting the forward corner of the blade up and raising it high, use the end to "peel" or shave off the material. Continue the operation until you bring the bank to the desired slope, or until you have a slope on which the tractor can operate.



Find out about the complete line of Bucyrus-Erie tractor equipment from your nearest International Tractor distributor. There are blades, scrapers, rollers, and grubbers that will give you speed and economy.

In all blade work, reduce backing up moves whenever you can. Plan all possible work to dig both ways not only to apply more of your time to moving dirt, but also because excessive back-up makes for excessive tractor maintenance.

**BUCYRUS ERIE**  
TRACTOR EQUIPMENT

SEE YOUR  
**INTERNATIONAL TRACTOR**  
DISTRIBUTOR

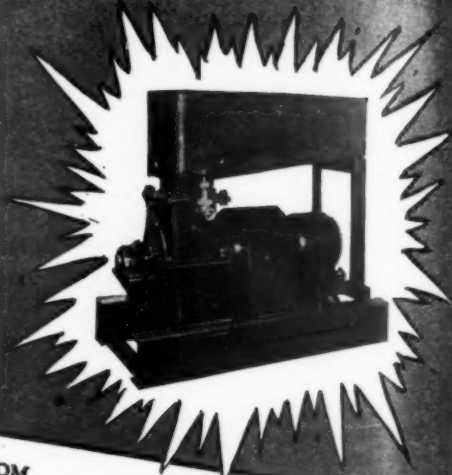


# Now it can be told!

Garbage and Refuse  
Shredders for U.S. NAVY

On Battle Ships—in Far Distant Islands—in the African Campaign—in Alaska—GRUENDLER Equipment in the War as in peace time, is doing an important job, a big job. New developments in Equipment Efficiency have been made and will be announced Post War.

**LET US ALL WORK FOR VICTORY NOW**



CLASS OF SERVICE  
This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or pre-

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**WESTERN UNION**

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TO THE MEN AND WOMEN OF GRUENDLER CRUSHER AND PULVERIZER CO=

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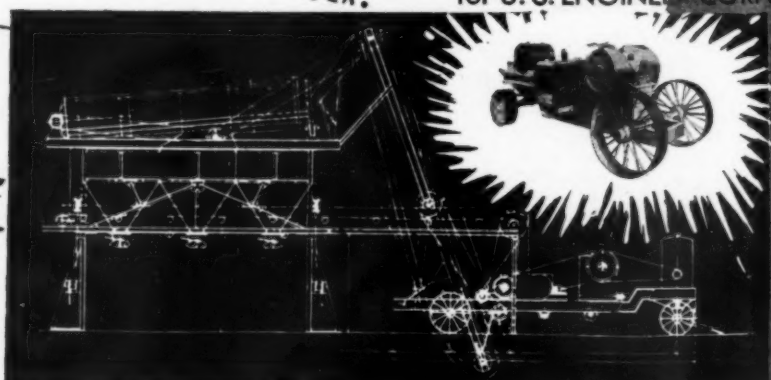
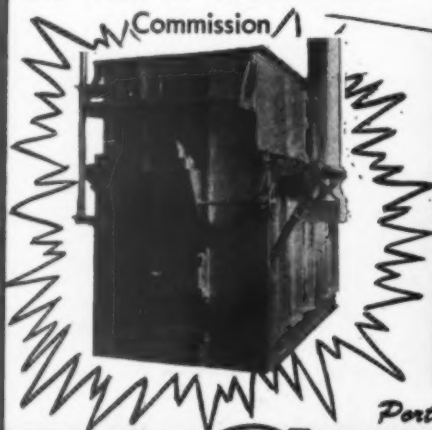
SYMBOLS	
DL=Day Letter	
NL=Night Letter	
LC=Deferred Cable	
NET=Cable Night Letter	
Ship Radiogram	
E at point of destination	

A US AIRCRAFT CARRIER, WHICH HAS STEAMED OVER 111,000 MILES ON VITAL MISSIONS DURING THE PAST TWO YEARS, REPORTS THAT YOUR GARBAGE GRINDER, CRUSHER AND PULVERIZER FUNCTIONED EFFICIENTLY AT ALL TIMES. THE SAFETY AS WELL AS THE CLEANLINESS OF A SHIP DEPENDS IN NO SMALL MEASURE ON THE PROPER DISPOSAL OF GARBAGE YOUR EQUIPMENT, IN DISPOSING OF GARBAGE WITHOUT A TRACE, IS VITAL TO OUR SHIPS OPERATING IN SUB-INFESTED WATERS=

*Armor Plate Plastic  
Mixers for U.S. MARITIME*

E L COCHRANE REAR ADMIRAL USN CHIEF OF THE BUREAU OF SHIPS. 1152A.

*Portable Crushers  
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Portable Crushing Plants for "Sea-Bees" U.S. Bureau of Ships and Docks

BUY  
WAR  
BONDS

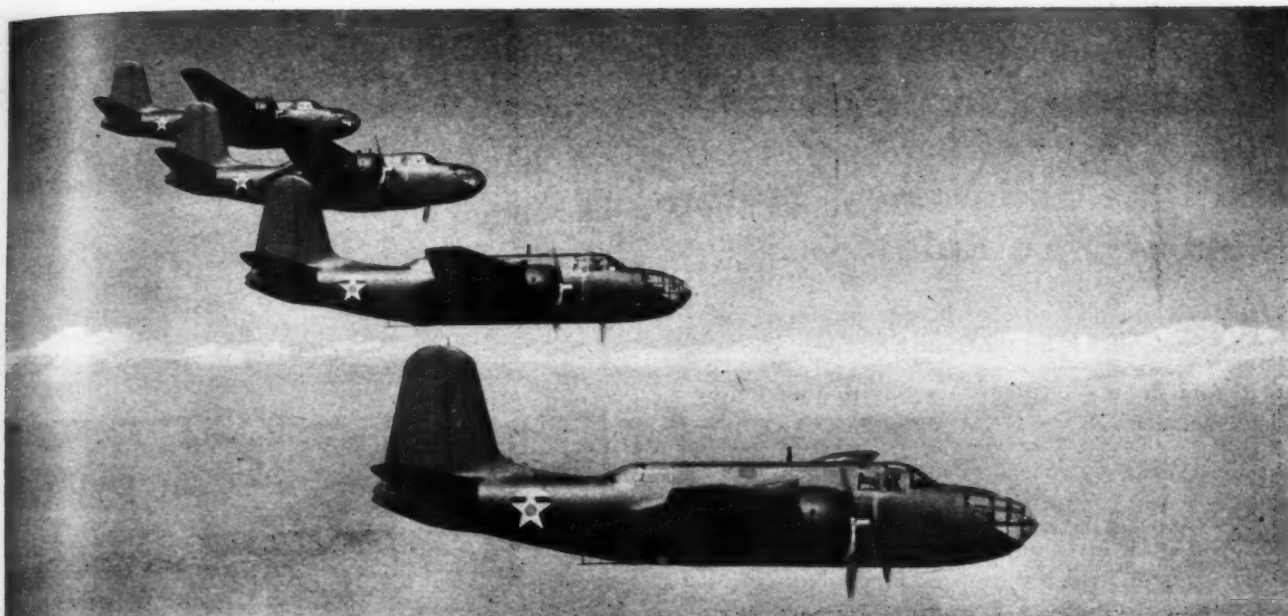
# GRUENDLER

CRUSHER & PULVERIZER COMPANY

ENGINEERS  
and  
MANUFACTURERS  
for over  
HALF CENTURY

2815-21 N. MARKET ST. ST. LOUIS, MO.





## *... that they may have a Happy Landing!*

**W**HEN these Army Air Force Bombers return from their mission over enemy targets, they must have a happy landing—runways that are long, wide and level.

Barber-Greene machines, in the hands of the Army Engineer Corps, are building those advance base runways faster and better—and on time! In every theatre of operation in the world, Barber-Greene runways are giving a fighting Army or Navy air force pilot a smooth take-off—his last feel of earth. Those runways first welcome him back, his mission successfully accomplished.

Runways built by Barber-Greene equipment speeded President Roosevelt, our Commander-in-Chief, to his momentous meeting with Prime Minister Churchill at Casablanca.

Standard B-G Asphalt Mixers, Finishers, Dryers, Loaders, tested and proved by many thousands of peacetime construction jobs, were ready when the Army needed them. Today, their production vastly increased, they are literally building the foundations for victory.

You can investigate this equipment now for your future needs—when victory is ours you will be ready with complete information. Our catalogs are yours without obligation. Write to: Bituminous Equipment Sales, Barber-Greene Company, Aurora, Ill., U. S. A.

Below is the Army Airport Plant, built by Barber-Greene for the Army Engineer Corps, and used in every theatre of operation in the world. Production of this equipment—THE STANDARD B-G LINE—has been vastly increased to help speed victory.



Awarded August, 1942



# BARBER-GREENE

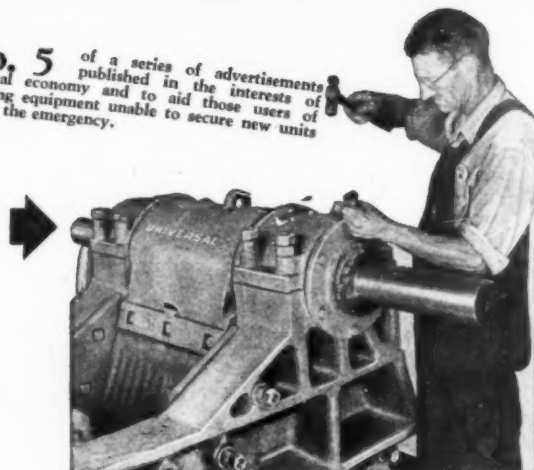
ROADS AND STREETS, December, 1943

## The Care and Maintenance of Rock Crushers

### Ten Time and Money-Saving Maintenance Rules:

1. Be sure there is no play in side bearings. Tighten locking nuts with a blunt chisel and hammer, as illustrated.
2. Before shutting off power, be sure that machinery is cleaned of all stone or gravel.
3. Keep your equipment clean and free of dirt and excess grease.
4. Tighten all loose nuts and bolts every morning or every night, and check them periodically during the day. Make a thorough check after moving to a new location. Loose parts cause rapid wear or serious breakage and costly delays.
5. Crusher and chassis should always be kept level
6. The key wedge should be kept close to the jaw. Insert shims behind wedge if necessary. Check wedge daily to be sure that it is tight; and that movable jaw remains centered.
7. Always adjust movable jaws when crusher is running empty, until they touch lightly. Then back them off slightly for clearance. Never allow them to pound. Tension spring should be just loose enough to allow free operation.
8. Don't raise or lower the adjusting wedge enough to cause a tilting in the toggle plate bearing wedge. Use a longer or shorter toggle to get the desired opening at the discharge opening of the jaws.
9. Be sure toggle seat on pitman is tight.
10. Be sure to use genuine parts—and see that they are properly installed. Follow instruction sheets or consult manufacturer.

No. 5 of a series of advertisements published in the interests of national economy and to aid those users of crushing equipment unable to secure new units during the emergency.



### UNIVERSAL ENGINEERING CORP.

Formerly Universal Crusher Co.

631 C Ave. West

Cedar Rapids, Iowa



They're giving their lives—  
let's lend our money!



# UNIVERSAL

CRUSHERS, PULVERIZERS, COMPLETE PLANTS, SPREADEROLLERS, PORTABLE ASPHALT PLANTS





## Bakers Clear Right-Of-Way for Pipe Line on Rim of Arctic!

Asphalt to extend and maintain the Alaska Highway, high octane gas for Japan-bound bombers and post-war cargo planes and diesel fuel for power in far north mines, canneries, pulp mills and fisheries will be made available by completion of the 600 mile long Canol pipe line in northern Canada.

This line will bring oil from wells at Fort Norman, Northwest Territory—trading post on the Mackenzie River—to a refinery under construction near Whitehorse, Yukon Territory.

Baker bulldozers are being used to doze trees, brush and rocks, fill gullies, level and grade, and to otherwise clear a right-of-way for the pipe line. This project was made necessary by the war and will pay off after the war, too. It will be unnecessary to haul petroleum products from the United States.

Baker hydraulic bulldozers with their direct lift and full down pressure on the blade are proving ideal for work in the frozen forest and wastelands.

The full weight of the tractor front end can be brought to bear on the blade—tough, frozen sub-arctic soils find their master in the Baker.

Send for Catalog 839.

**THE BAKER MFG. CO.**  
 506 Stanford Ave., Springfield, Ill.



The truck of the crew and equipment to Fort Norman.



Section of right-of-way cleared by Baker Bulldozers.



Baker overhead tie rod protects cab and operator against falling timber.



Awarded the Army-Navy "E" Flag for proficiency in production.

# BAKER

The Modern Tractor Equipment Line  
 for  
 EARTH MOVING  
 LEVELING AND GRADE BUILDING  
 SNOW REMOVAL  
 ROAD MAINTENANCE

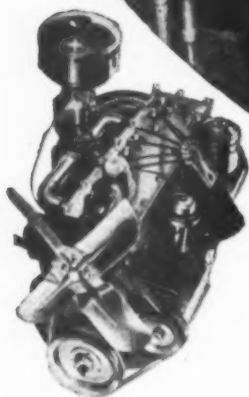


# RING-FREE REMOVES CARBON REDUCES FRICTION, SAVES FUEL!



**MACMILLAN  
RING-FREE  
MOTOR OIL**

## Don't Deprive *Any* Power Plant Of This Operating Economy!



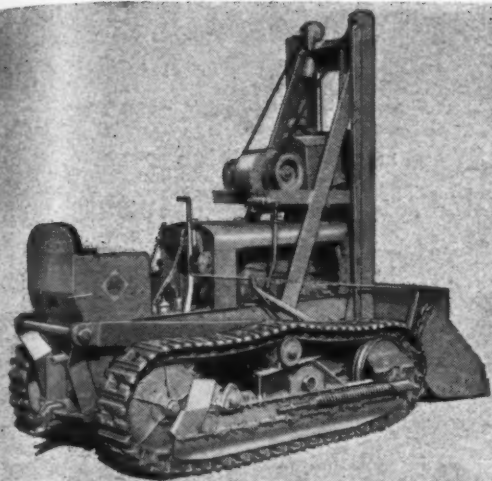
Carbon trouble is expensive in downtime and repair bills on all sizes and types of Diesel and Gasoline engines. In every engine suffering from carbon, the first crankcase full of Macmillan RING-FREE Motor Oil begins to *remove* the carbon from pistons, rings, valves *while the engine runs*. Continued use of RING-FREE keeps the formation of destructive carbon in check. The result is a cleaner, more thoroughly lubricated, sweeter running engine.

Another, even greater RING-FREE advantage is its ability to reduce friction *fast!* That actually delivers more power to the drive shaft . . . produces measurable fuel savings. It also cuts down wear and repair. Many operators who started by lubricating just one of their engines with RING-FREE were so convinced by the performance and economy obtained that they now order Macmillan RING-FREE for *all* their motorized equipment.

**MACMILLAN PETROLEUM CORPORATION**

50 West 50th Street, New York 20 • 624 South Michigan Avenue, Chicago 5 • 530 West 6th Street, Los Angeles 14  
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REDUCES WEAR BY REDUCING FRICTION



### Extra Duties

#### Which Keep Hough Shovels Busy

Snow removal and loading — ditch and stream cleaning — handling catch basin and sweeper refuse — loading under viaducts, underpasses or indoors — tree removal and loading — handling pipe, poles, ties, rails and culverts — charging asphalt and concrete mixers — and hundreds of other time-saving applications. The tractor is, of course, adaptable to all normal uses.

## Lubricating Schedules For Today!

With new Hough Cable Operated Tractor Shovels difficult to procure, those in service are being operated far in excess of normal hours; which implies the need for greater lubrication and maintenance care. Hough equipment will function faithfully for long periods if proper maintenance practices are observed.

In the matter of lubrication, take a tip from the U. S. Engineers, whose *greasing period is eight hours instead of one day*. The crew finishing an eight hour shift lubricates all points indicated for "once a day" lubrication. At the end of the second eight hour shift, the crew going off duty lubricates all "once a day" points, and any "two day" points which may be shown. This schedule is carried out through multiples of eight hours to the equivalent of the period when the equipment should receive a general overhaul.

Use only clean SAE 10 oil (U. S. Engineers OE



# HOUGH

"HUFF"

Tractor Shovels  
Road Sweepers



Awarded the  
"E" flag for  
proficiency in  
production.

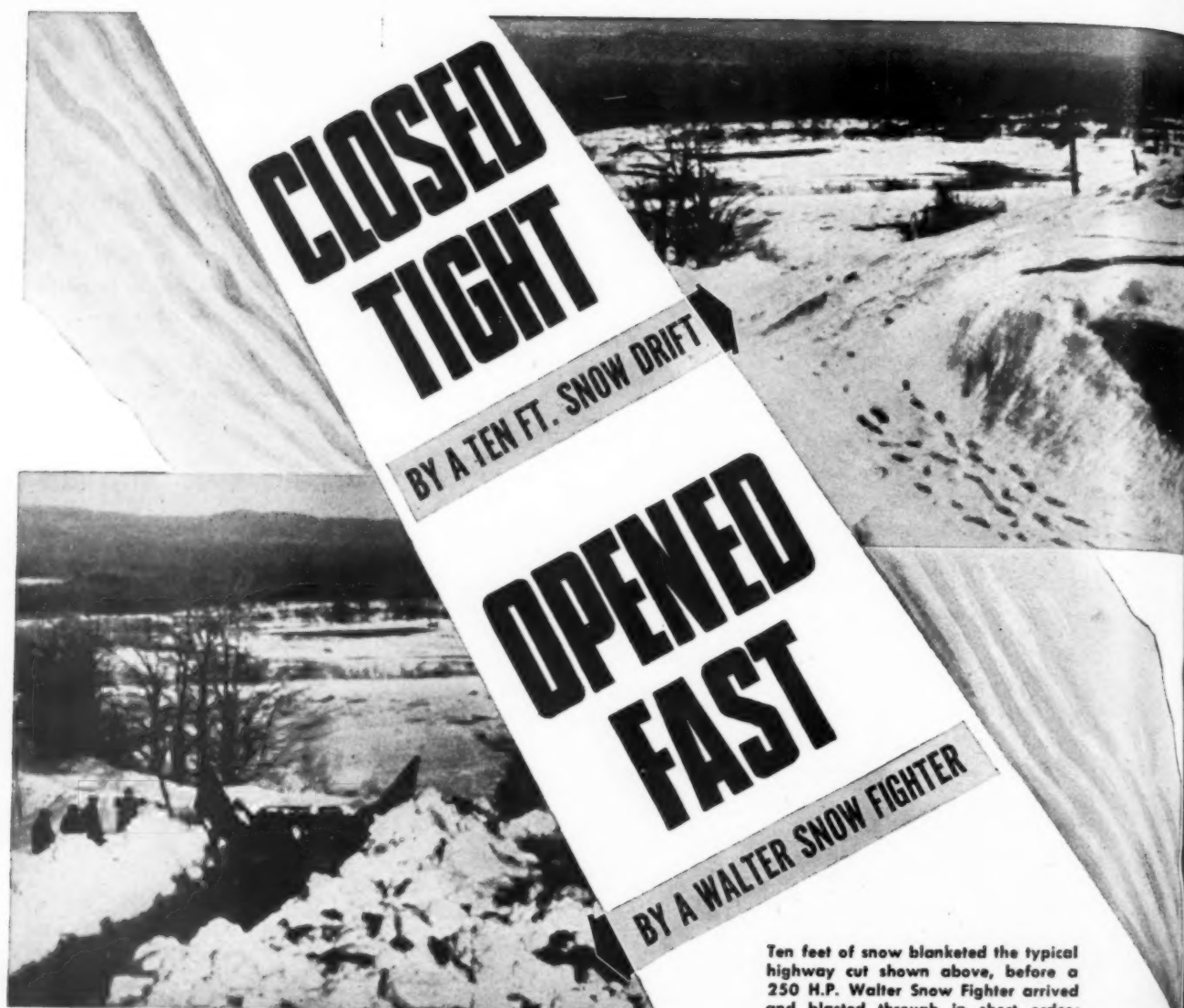
10). Keep wear strip and guide frames well greased. Change the oil filter element frequently; flush hydraulic system every 400 hours.

If you treat your Hough Shovels right, they will serve you long and well. Can we help you with your operating and maintenance problems?

**THE FRANK G. HOUGH CO.**

Libertyville, Illinois

"Since 1920"



**CLOSED  
TIGHT**

BY A TEN FT. SNOW DRIFT

**OPENED  
FAST**

BY A WALTER SNOW FIGHTER

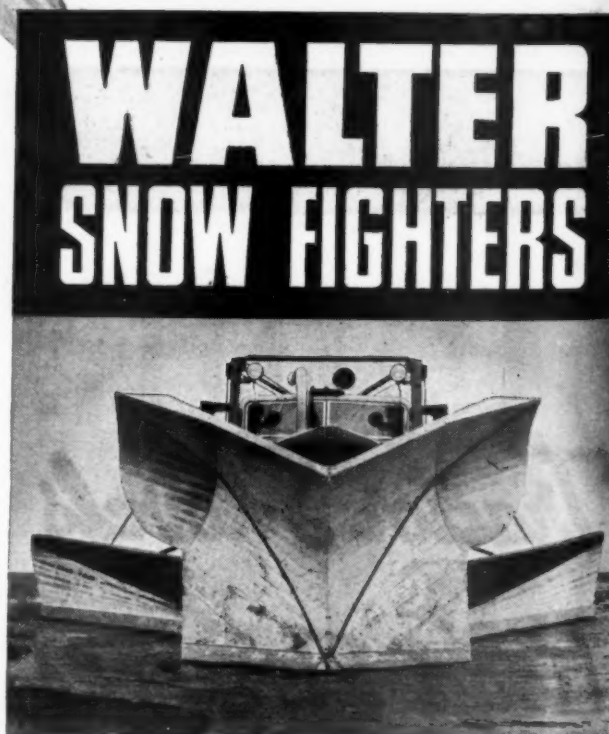
Ten feet of snow blanketed the typical highway cut shown above, before a 250 H.P. Walter Snow Fighter arrived and blasted through in short order.

• Tremendous power—plus the ability to turn that power into smooth, positive traction—is the combination that enables Walter Snow Fighters to “gobble up” the toughest highway snow removal jobs.

Through the unique action of Walter Four-Point Positive Drive, the full rated horsepower of the motor is delivered to each of FOUR driving wheels . . . according to its traction at any instant. There is no slipping, stalling or “wheel spinning”—just a steady, powerful “driving-ahead” that smashes mammoth drifts and runs the Walter Snow Fighters at relatively high speeds through level stretches of deep snow. At such speeds, the snow is hurled to the side—not merely “turned over” as is the case with slower, conventional trucks.

For the complete story on Walter Four-Point Positive Drive and many other specialized mechanical features of Walter Snow Fighters, write for detailed literature or consult your nearest Walter distributor.

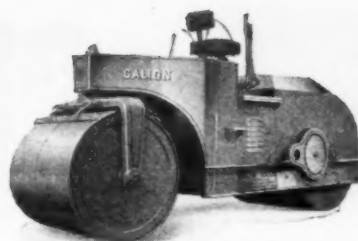
**WALTER MOTOR TRUCK COMPANY**  
1001-19 IRVING AVENUE, RIDGEWOOD 27, QUEENS, L. I. N. Y.







Galion 3-wheel rollers—Warrior 6 to 8 tons; Chief 10 to 14 tons.

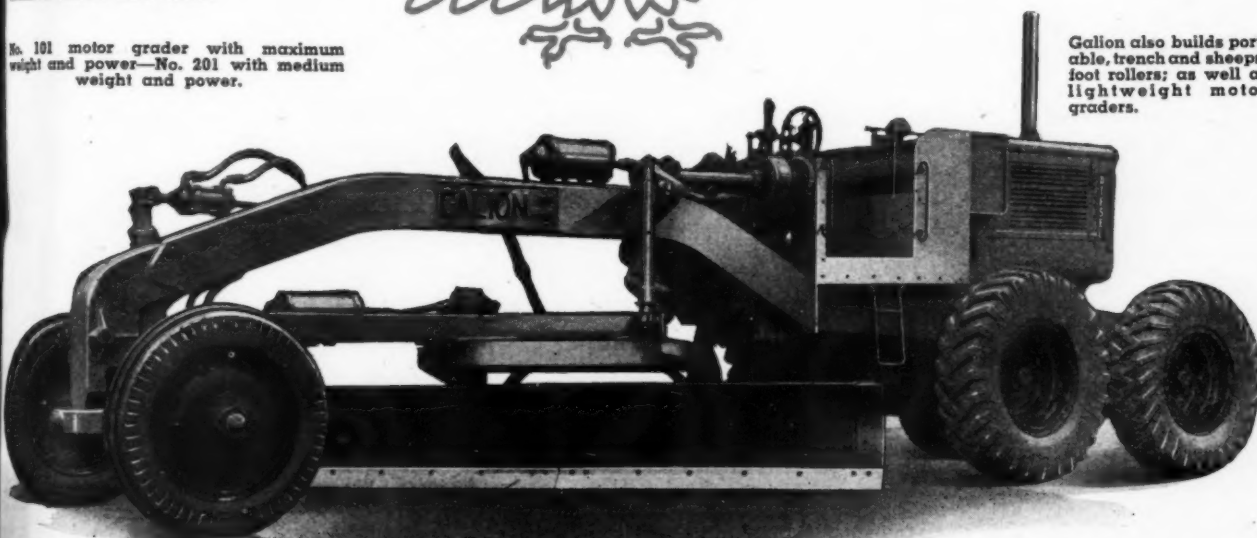


Galion tandem rollers—5 to 14 tons; gasoline or diesel motor.

## PLANS NOW ASSURE PROGRESS AFTER

While we realize that the war is far from being over, we do not think it is too soon to project the broad Galion line of road machinery into post-war planning wherever it's being done. By continued development, Galion expects to contribute much to progressive road construction and maintenance after the war.

No. 101 motor grader with maximum weight and power—No. 201 with medium weight and power.



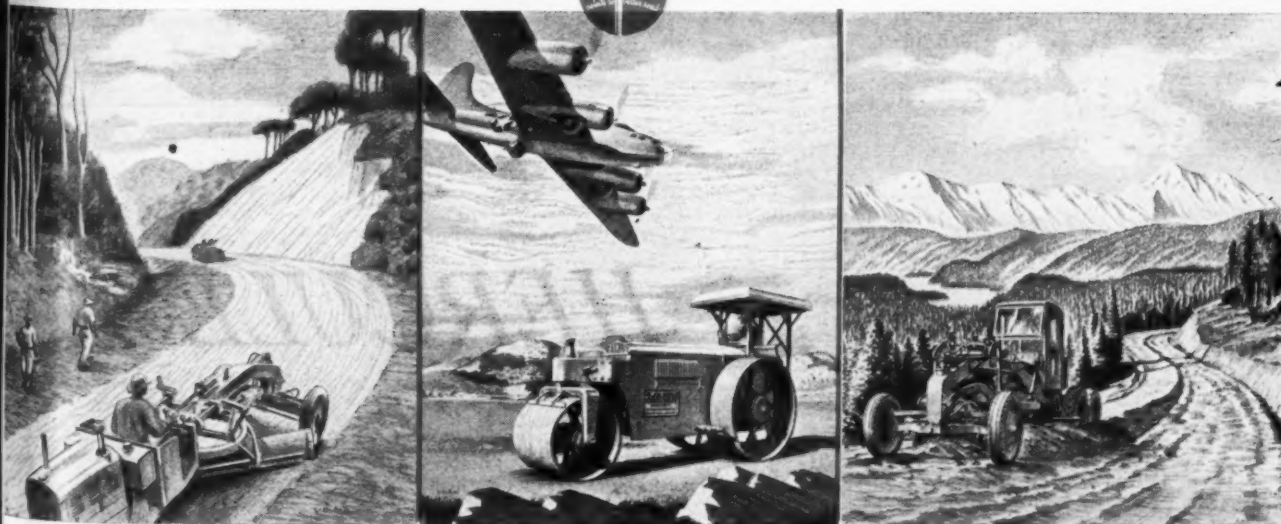
In the meantime, Galion continues to serve with essential rollers and graders (see drawings below) in all branches of the service . . . is helping with the progress of the war. We must do all we can to hasten the final Victory—that's our common task. We must think of the future, too.

Galion also builds portable, trench and sheep-foot rollers; as well as lightweight motor graders.

## THE GALION IRON WORKS & MFG. CO.

MAIN OFFICE & WORKS:

GALION, OHIO



# **VINSOL TREATED** CEMENT SCORES IN ARMY TESTS !...

see below

**concrete beams . . .  
stronger now than  
when installed.**

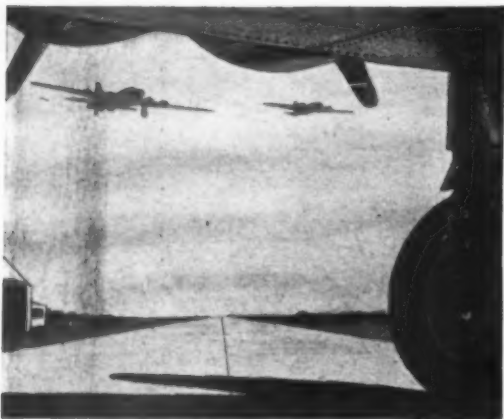
**TREAT ISLAND, MAINE . . .** A remarkable improvement in the frost-resistance and toughness of cement can be achieved by adding small amounts of Hercules Vinsol® Resin, army tests demonstrate.

Conducted by the Corps of Engineers, U. S. Army, the tests were started three years ago with 273 test beams of various types of concrete, installed on Treat Island, Maine. During the winter months, the best beams were subjected to alternate freezing by Maine winds and thawing by salty flood tides. Although all of the normal-cement concretes deteriorated rapidly under this gruelling treatment, the Vinsol-treated cements *not only remained intact, but are actually stronger today than when originally installed.*

**FOR RUNWAYS, HIGHWAYS . . .** Vinsol-treated cement has been found exceptionally effective for runways and highways—both for improved frost resistance and for successful checking of scaling caused by chloride salts in modern ice-cleaning methods. Technical information on Vinsol, and requirements for all vital construction, are available from Hercules. Write in, today.



**0.05% VINSOL, MAXIMUM . . .** Although only 0.05% of low-cost Vinsol was used in the army tests, as little as 0.025% of Vinsol is being used in many cases. Introduced during the clinker-grinding operation, the Vinsol improves not only frost and scaling resistance, but also plasticity and workability of the cement mixes.



ROADS AND STREETS, December, 1943



NAVAL STORES DEPARTMENT

## **HERCULES**

### **POWDER COMPANY**

INCORPORATED

972 MARKET STREET . . . WILMINGTON 99, DELAWARE



# POWER THAT "DELIVERS"

...at Home and on  
the *Fighting Fronts!*

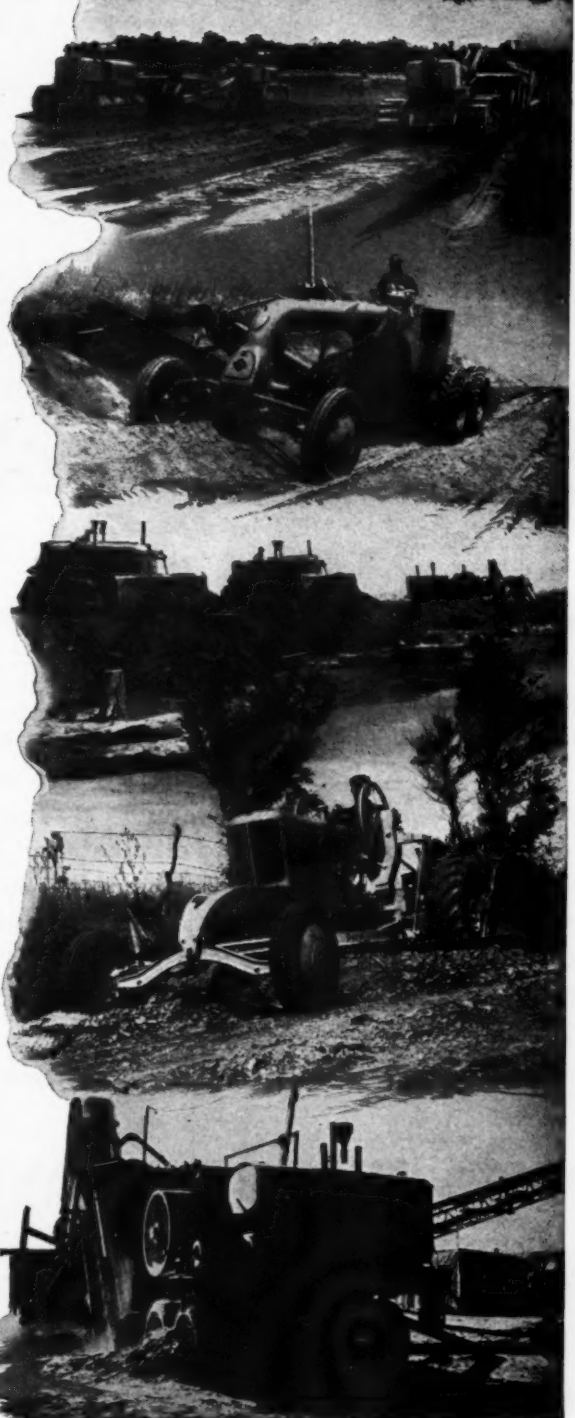
As the echo of rumbling tractors fades out in one section of the world it is picked up by another. At nearly every place on the face of the earth, these "battlewagons" and other construction machines are busy helping to change the tide of war — at the fronts, behind the fronts... here at home and abroad.

Construction men who are smashing all records building this Arsenal of Democracy know well the job that fast-moving, powerful, Allis-Chalmers 2-Cycle Diesel tractors and companion equipment are capable of accomplishing. Equally impressive is their record-breaking performance on the fighting fronts. In the thick of it everywhere, they help to speed up the offense — clearing jungles and building roads, constructing bridge approaches, airports and new bases, hauling big guns, pushing or pulling tanks and trucks through mud, mire and water... helping to keep the fighting men and their mechanized units rolling ahead.

Every unit we turn out for Uncle Sam and our Allies hastens the end of the struggle. You who have immediate need for construction equipment, and at present can't obtain all you want, can take real satisfaction in the thought that the machines you might have had are being put to such good use.



**ALLIS-CHALMERS**  
TRACTOR DIVISION - MILWAUKEE, U. S. A.





# Giving Gremlins The Gate...



*Heavy Wreckers (M-1) made by Ward LaFrance carrying 20,000 lb. loads on routine test run. Road test load exceeds gross weight of finished vehicle.*

● GREMLINS are notorious hitch-hikers... always anxiously awaiting the chance to catch a ride on an indispensable piece of war equipment and foul it up at the most crucial time.

Here at Ward LaFrance we have "open season" on the troublesome creatures... systematically seeking them out and eliminating them long before they can grow up to commit more serious crimes on men and machines. Our successful method of dealing with truck Gremlins is unique with Ward LaFrance.

*We take them for a ride!*

It's so tough they give up. After a peaceful

period of pleasure riding they begin to cry out. They can't understand why a truck has to carry a 20,000 lb. load at full speed... sudden stops and starts... uphill and down. We can tell them.

It's a routine test run given every Tank Recovery Truck made by Ward LaFrance. And, if you don't think it gets results... just ask the Gremlins.

When planning your post-war replacements, investigate Ward LaFrance first. Learn about trucks engineered, built and tested for specific jobs. You'll be glad you did.

## WARD LaFRANCE TRUCK DIVISION

ELMIRA,



NEW YORK

# STRIPPED FOR ACTION IN NEW GUINEA



## THIS OSGOOD "20" . . .

. . . is clawing a military road out of the stubborn, tangled New Guinea jungle. Other Osgoods are at work every day in every war theater—"dishing it out" and "taking it"—in rock, hard clay, mud, snow and sand. And no job is too tough!

All this world-wide, campaign-proved performance hastens the day when Osgood ruggedness, power, maneuverability (Osgood measured air control) and complete dependability can again go to work for you. With that in mind, why not check with Osgood now!



Keep your equipment rolling  
with preventative maintenance.



Keep the attack rolling with  
more War Bonds.

### The GENERAL EXCAVATOR CO.

Sizes: 3-12-36-34  
DIESEL - GAS - ELECTRIC

Associated with  
THE OSGOOD CO.

### The HERCULES COMPANY

HERCULES  
\*IRONEROLLERS\*  
6 to 12 Tons  
Diesel or Gasoline

Associated with  
THE OSGOOD CO.

# OSGOOD

Sizes:  
1/2 to 2 1/2 Cu. Yd.  
Diesel - Oil - Gas - Electric

## SHOVELS

DRAGLINES - CRANES  
Crawler & Wheel Mounted

THE OSGOOD COMPANY Marion, Ohio



*Buy*  
**WAR  
BONDS!**

*They're* **"BLACKHAWK HYDRAULIC-EQUIPPED"**

**L**ONG before the war, leaders in many fields, whose trademarks you respect, proved the remarkable efficiency of Blackhawk Hydraulic Controls.

Today, Blackhawk Power-Packer HYDRAULIC Units are proving their many advantages to an extent far beyond pre-war conceptions...forecasting still greater achievements in the postwar era to come. Whether your needs are for hand or pow-

er control, service-proved Blackhawk Hydraulic units assure you dependable power for lifting and lowering — with speedy action, peak efficiency, and remarkable accuracy and ease of control. Specify "Blackhawk Hydraulic controls" when modernizing or buying equipment... For complete list of advantages, write your equipment manufacturer — or write us direct.

**A Product of BLACKHAWK MFG. CO., Dept. RS, Milwaukee, Wis.**

# BLACKHAWK

*Hydraulic Equipment*



# WINTER'S

# Blockade!

## Practical Hints for Winter Operation and Maintenance of FWD Snow Removal Trucks

Here are some practical suggestions on how to get the most in performance with minimum maintenance out of FWD snow removal trucks:

**CONSERVE TIRES** — snow removal truck operators are universally agreed that single tires are best in snow removal service. The use of single tires of the same size on all four wheels not only conserves rubber but also reduces excessive differential action, thus prolonging the life of the truck. Closely spaced tire chains — not emergency chains — should be used on all four wheels for maximum traction and least slippage and damage to tires.

**CARE OF ENGINE** — change engine oil frequently enough based on total hours of operation. Keep cooling system clean and free of rust. Control engine temperature with a radiator hood or automatic shutter.

**STORING THE TRUCK** — sub-zero temperatures make lubricants too stiff and solid, cause steels to become brittle. House all your trucks when not in use — avoid outdoor storage for longer truck life.

**INSPECT YOUR TRUCKS** — periodically and check for needed replacements — take advantage of FWD's principle of progressive interchangeability of improvements and vital parts.

### SEE YOUR FWD BRANCH OR DEALER

The entire FWD organization of factory branches, FWD dealers, and district servicemen are all pledged to help you get the most out of your trucks by aiding your program of preventive maintenance. Call on them frequently for sound maintenance advice and skilled service.

**THE FOUR WHEEL DRIVE AUTO COMPANY • CLINTONVILLE, WISCONSIN**  
Canadian Factory: Kitchener, Ontario



Night and day hundreds of FWD snow removal trucks keep airports and highways clear so that vital wartime transportation and communication can be carried on without interference.



Single tires instead of duals and plenty of chain make the ideal snowplow combination—one which does the job and conserves the truck.

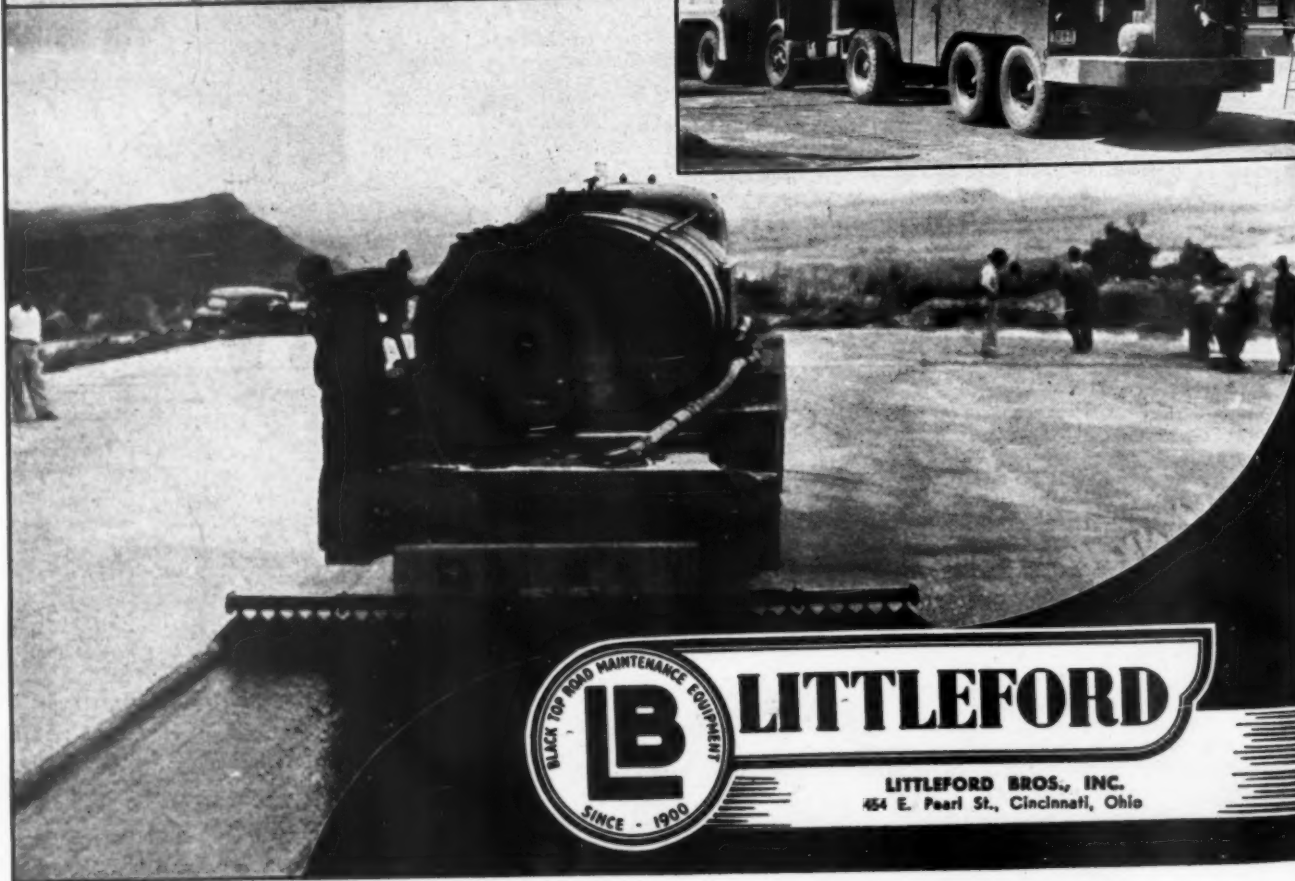
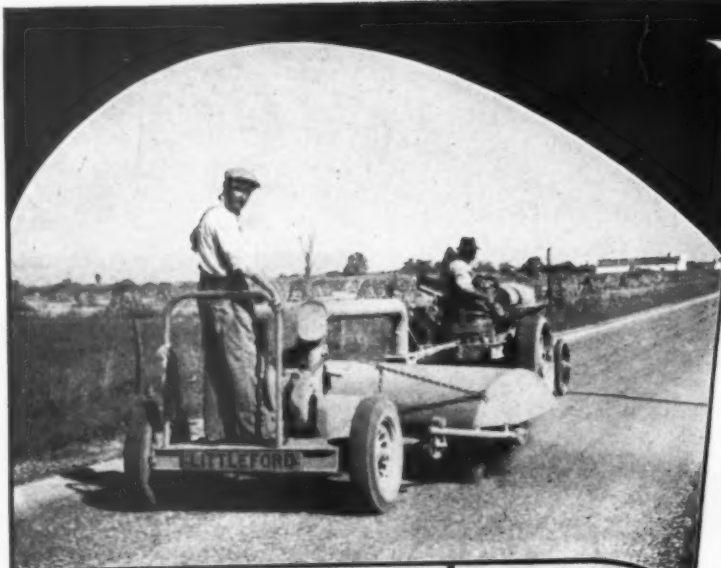


House trucks in warm quarters when off the job and when servicing. Sub-zero temperatures make lubricants too solid, cause steel to become brittle. Avoid outdoor storage for longer truck life.



*Preferred*  
**FOR FAST LOW COST  
SNOW CLEARING**





## THEY'RE FIGHTING FOR VICTORY

Littleford Black Top Construction and Maintenance Units are fighting all over the world for Victory. They are building Runways, Roads, Highways, etc., to speed the day of peace. Pressure Distributors, "Tanka" Heaters, Road Brooms, and Supply Tanks are in all theatres of War.

After Victory these proven Littleford Units will again speed up the Construction and Repair of our Highway and Airport systems. On the battlefield and at home, Littleford units give the most efficient results. Remember to purchase your Post War Black Top Construction and Maintenance Equipment that bears the Littleford Trademark.

Upper Left—Road Broom.  
Lower Left—"Tanka" Heater.  
Bottom—"Spray Master" Pressure Distributor.  
Right—Bituminous Supply Tank.



# LITTLEFORD

LITTLEFORD BROS., INC.  
454 E. Pearl St., Cincinnati, Ohio



# Alaskan Proving Ground — for POST-WAR



Shaping a shoulder on a stretch of the Alaska Highway. The International TD-18, with 6-yard scraper, is operated by Leo C. DuChamp, Thief River Falls, Minn.

## Right Now It's a Mighty Military Road that INTERNATIONAL TracTracTors Helped Build

**I**F EVER a highway earned the right to be called a proving ground, the Alaska Highway has done so. Only the toughest road-building equipment got the call when construction began. Only the toughest equipment stayed on the job through the grueling months that followed. Tractors and trucks, scrapers and graders, and the men who ran the show, made road-building history on this great construction job. Here was a proving ground dedicated to Victory, destined to influence post-war construction and REconstruction.

The Alaska Highway is a mighty military road now, a road that International TracTracTors helped

build. This assignment is only one of many that these powerful crawlers are taking in their stride. Tens of thousands of war-gearred Internationals serve in all branches of the Armed Services . . . as prime movers of big guns, smoothers of bomb-torn landing fields, clearers of jungle.

When it's time to carry on beyond Victory, Internationals will be readier than ever to tackle the toughest jobs of peacetime. Count on International Power then . . . to help *rebuild* the world.

**INTERNATIONAL HARVESTER COMPANY**  
180 North Michigan Avenue Chicago 1, Illinois

# INTERNATIONAL POWER



# Pavement Scaling Solved



Sections from Universal Atlas original test road after 60 cycles of salt de-icing treatment.

**Concrete made with Atlas DURAPLASTIC air-entraining portland cement resists freezing, thawing, and salt de-icing treatment as demonstrated by tests and proved by street and highway installations**

These photographs of sections from the Universal Atlas original test road, built in 1938 at its Hudson, N. Y., plant, show the results of 60 cycles of freezing, thawing, and heavy salt de-icing applications—the equivalent of many winters of actual service. Note the condition of the standard cement section (left), while the DURAPLASTIC section (right) is 97% scale-free.

The results of this test road and this discovery by Universal Atlas have been substantiated on more than a score of street and highway installations in over a dozen states. Many of these have been through three or four winters, and all are scale-free. No oil or other protective surface treatment has been employed. In some of these areas, air-entraining portland cement is now the required standard for such street and highway work.

Atlas DURAPLASTIC is a true portland cement in which a small, precise quantity of the air-entrain-

ing material has been interground during manufacture in accordance with current Federal and ASTM specifications. In addition to all the properties which have made portland cement the favorite paving material, DURAPLASTIC has the added advantages of improved workability and greater durability.

Our Technical Service Bureau will provide detailed information on DURAPLASTIC—the cement that

makes concrete scale-resistant. Write today. Ask for a copy of "Pavement Scaling Successfully Checked." Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

**OFFICES:** New York, Chicago, Albany, Boston, Philadelphia, Pittsburgh, Minneapolis, Duluth, Cleveland, St. Louis, Kansas City, Des Moines, Birmingham, Waco.

## QUICK FACTS about Atlas DURAPLASTIC\* cement

1. Complies with current Federal and ASTM specifications.
2. Renders concrete pavements highly resistant to scaling due to the action of salts used for ice removal.
3. Protects concrete against the effects of freezing and thawing weather.
4. Minimizes segregation and bleeding. Concrete is more uniform throughout and more durable.
5. Permits earlier finishing.
6. Requires no additional materials at the mixer.
7. Called **DURAPLASTIC** because it makes concrete more durable and more plastic.

\*Trademark registered, U. A. C. Co., all rights reserved.

RS-D-3



**ATLAS DURAPLASTIC CEMENT**  
A Universal Atlas Product

# WAR

**has proved again...**

**No other existing equipment can  
prepare subgrade as quickly,  
cheaply and accurately as a  
Buckeye R-B Power Finegrader.**



It is significant that on a big percentage of road and airport runway jobs during this war period, when speed and good work were paramount, that Buckeye R-B Power Finegraders were put to work ahead of the pavers. At the record-breaking Willow Run bomber plant job, four complete paving outfits, each with an R-B Finegrader were used. On military access roads, offshore bases, black top and concrete air bases and many others . . . R-B Finegraders paced operations. In prewar road construction, 19 of the contractors on The Pennsylvania Turnpike used R-B's. On post-war work, contractors who have reviewed these records will make Buckeye R-B Power Finegraders an integral part of their paving outfits. Send for descriptive literature now while the subject is fresh in your mind.

**BUCKEYE TRACTION DITCHER CO.**  
Findlay, Ohio



# Buckeye✓

Tractor Equipment    Trenchers  
Road Wideners        Spreaders  
Power Finegraders    Convertible Shovels

## LOOK AHEAD

Road construction is the key to post-war economic balance. The American Road Builders Association plan shows that a \$3,000,000,000 postwar road, street and highway program is needed to meet the nation's needs. Here is an important source of jobs when our service men come home. Will your city, county and state be ready with completed plans?

ROADS AND STREETS, December, 1943

*Never before in any war...*

*motorized equipment that pulls  
itself up by bootstraps of modern*

## *Preformed wire rope*

Dragging a heavy field piece through trackless wilderness, the sturdiest "cat" may bog down and stall in deep and slippery mud.

In this emergency the line of Preformed Wire Rope on the front winch is securely anchored to a rock or tree up ahead. Then, with a strong and steady pull, the "cat" inches its way out of trouble and resumes its journey.

Preformed Wire Rope handles these patient, ponderous jobs as well as the hair-trigger reactions of airplane controls—as easily as the thousands of everyday jobs. Preformed Wire Rope wears longer, speeds work, reduces accidents, slashes costs. If you haven't tried Preformed Wire Rope—

*Ask your own wire rope manufacturer or supplier*



The  
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*Plan with*

# Pioneer

## ENGINEERING WORKS

Jaw Crushers • Roll Crushers • Screens • Conveyors • Feeders • Washers

MINNEAPOLIS 13, MINNESOTA

ENGINEERS and MANUFACTURERS of QUARRY-GRAVEL AND MINING MACHINERY

The best way to lick any job is to plan to lick it . . . to make sure that your equipment meets the requirements of the job with adequate margins . . . and meets also your personal requirements as to dependability, original investment, low processing and maintenance costs. It is for these reasons that more and more operators plan first to determine their own requirements, and *Plan with Pioneer*.

Planning with Pioneer puts at your disposal, sitting on your side of the desk, an engineering and manufacturing organization that can be of genuine help to you in selecting the type and size of any Pioneer equipment you need.

Pioneer engineering is of two phases. First is the designing of units that will do best, certain specific types of jobs. The second phase is one of coordinating these Standard Pioneer Units into a complete plant, so that all units are in balance functioning at high efficiency with relation to each other, to form a compact, integrated plant producing at a profit.

Pioneer offers you *more for your money* in terms of service, machinery and dependable continuous operation at a profit. Planning with Pioneer involves no obligation. An outline of your complete requirements and Pioneer's cooperation in advance planning to meet them, is the surest solution for your processing job. Plan first to Plan with Pioneer.

# Pioneer

## ENGINEERING WORKS

Crushers • Screens • Conveyors • Feeders and Portable Plants

MINNEAPOLIS 13, MINNESOTA

ENGINEERS and MANUFACTURERS of QUARRY-GRAVEL AND MINING MACHINERY

## Everything Under Control ... OF THE "BIG VOICE"

Commands and instructions over loud speakers direct the operations of landing forces and combat units. To operate these, and other communication systems, power is supplied by portable gasoline engine powered generators. One more combat duty added to the many standard and special applications powered by hundreds of thousands of dependable, instant-starting, 4-cycle, air-cooled Briggs & Stratton engines now serving our armed forces.



INQUIRIES are requested from those manufacturers who require portable gasoline engine power for war production — or for their post-war gasoline-powered equipment now being planned.

We are better prepared than ever to carry on the traditions of Briggs & Stratton engines — with the same high standards of quality and precision manufacture, their rugged dependability, easy starting and economical performance — all the features that have earned for Briggs & Stratton the reputation of "the world's finest air-cooled gasoline engines."

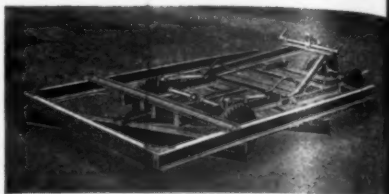
"It's powered right — when it's powered by Briggs & Stratton"

BRIGGS & STRATTON CORP.  
MILWAUKEE 1, WIS., U. S. A.

BACK THE ATTACK  
BUY WAR BONDS



## NEXT SPRING



There will be Roads and Shoulders to maintain. A BURCH drawn type road maintainer will do the job better than any other because it is scientifically designed. Can be used in connection with Tractor or Truck. Power or hand hydraulic control as desired. Plan your spring work now.

Manufactured by

The BURCH CORPORATION

Crestline, Ohio

Equipment Since 1875

## MANGANESE CAST POINTS for SHARPENING Digger Teeth



Quick  
Economical  
Repair by  
Welding.  
Sharp Teeth  
Save Power.  
Immediate  
Shipments On  
M.R.O. Priorities

Send For  
Bulletin RS-51



ALLIED  
STEEL PRODUCTS, Inc.  
N.B.C. BLDG. • CLEVELAND 14, OHIO, U.S.





Now, In War-Supply Service, This Concrete Curing Agent  
Is Getting *Terrific Abuse* . . . and Taking It In Stride!

**I**N any month of war service, SISALKRAFT is taking more punishment than it would *ever* get as a curing agent on a concrete road or floor job — and taking it in stride!

The outstanding waterproof qualities of SISALKRAFT, plus its ability to resist scuffing, as proved on thousands of concrete jobs, make it an essential war need to protect supplies to fighting fronts. Such supplies must arrive ready for use, despite constant exposure to sleet, snow,

ice, wind and salt water during thousands of miles of travel!

The toughness of SISALKRAFT, and its ability to resist moisture, shrinkage and dry rot, have enabled it to do this vital war job with admirable success.

That is why SISALKRAFT production is devoted to essential war needs. When it's over, over there, SISALKRAFT blankets, covers and rolls will again be ready to serve you as dependably as they are now serving our armed forces.

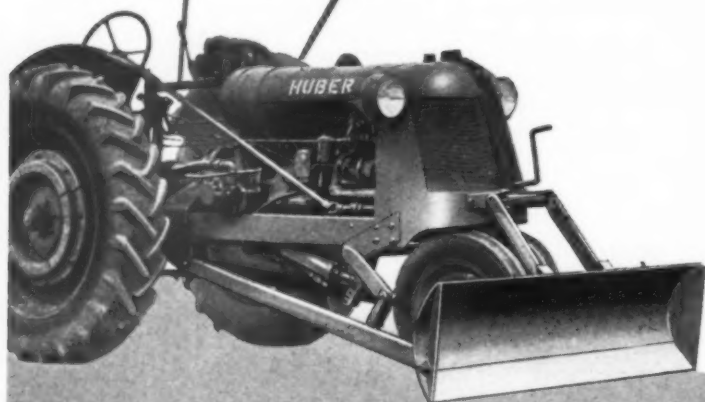


SERVING INDUSTRY . . .

CONSTRUCTION AND AGRICULTURE THROUGHOUT THE WORLD



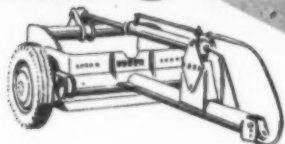
Where there's Fighting to be Done  
**HUBERS**  
 are in the Thick of it !



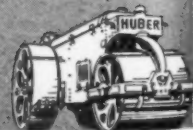
Keeping constant watch over landing fields subject to enemy bombardment . . . keeping highways in repair for the uninterrupted flow of supplies to the fighting front . . . rolling out new roadbeds where they never existed before . . . this is the work Huber Bulldozers, Rollers and Speed-Scoops are doing in all parts of the world today . . . and where the fighting is thickest. It is a tribute to the outstanding, untiring performance of these machines.

THE HUBER MFG. CO., Marion, O.

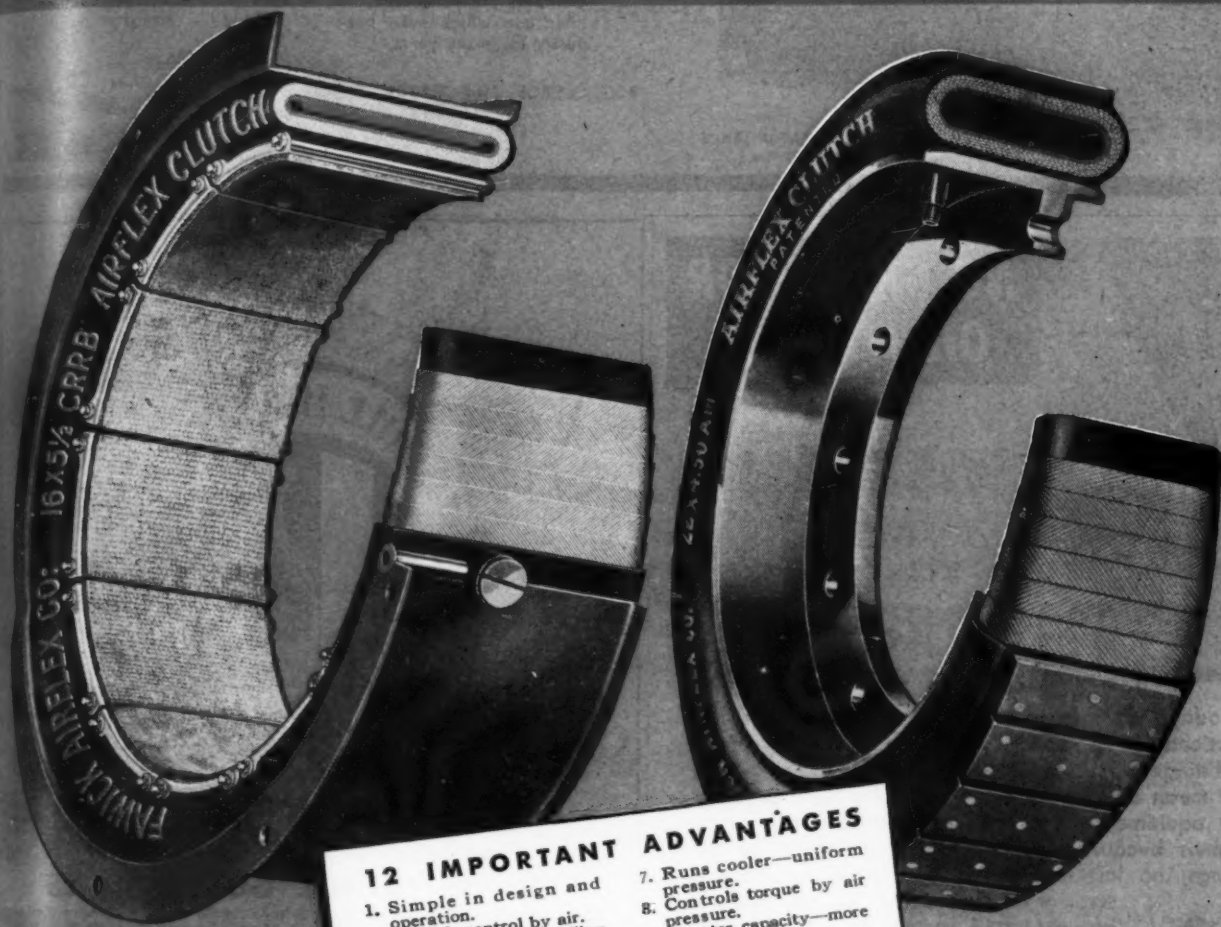
# HUBER BULLDOZER



**SPEED SCOOPS • ROLLERS**



# THE CLUTCH THAT CANNOT FAIL— *built for Heavy Duty service*



**EXTERNAL  
CONSTRICTING  
TYPE**

**INTERNAL  
EXPANDING  
TYPE**

## 12 IMPORTANT ADVANTAGES

1. Simple in design and operation.
2. Flexible control by air.
3. No adjustments or oiling—low maintenance.
4. Dampens vibration—absorbs shocks.
5. Corrects misalignment automatically.
6. Smooth starting—no jerks.
7. Runs cooler—uniform pressure.
8. Controls torque by air pressure.
9. Greater capacity—more compact.
10. Remote control by air valve.
11. Replaces couplings.
12. Acts as clutch, slip-clutch or brake.

A new principle—control of power and torque by air—makes it possible for the Fawick Airflex Clutch to perform under conditions that other types of clutches cannot handle.

With the Fawick Clutch, there is no vibration—shocks are absorbed by a cushion of air. No

levers or toggles—no adjustments to make—no lubrication needed. Maintenance is very low—operation very economical.

If your product needs a heavy-duty Clutch, Brake, Slip Clutch or Flexible Coupling, write us for recommendations.

**FAWICK AIRFLEX COMPANY, INC.**

**9919 Clinton Rd.**

**Cleveland 11, Ohio**

In Britain, Crofts Engineers, Ltd., Bradford, England

# FAWICK *Airflex* CLUTCH

POWER CONTROLLED BY AIR

EXPERIENCE  
Builds 'emPERFORMANCE  
Sells 'em

AMERICA'S shipbuilding industry will launch more ships in 1943 than all the rest of the world combined.

ROGERS TRAILERS are a vital link in the mass-production method of ship construction for they are transporting heavy machinery . . . boilers, bulkheads, engines . . . speeding Victory ships down to the sea!

## on ROGERS TRAILERS

ROGERS TRAILERS are serving efficiently on the home-front too and new models which will be available when war contracts are completed, will be even more efficient than the multitude which have been so successfully operated by industry for many years.

ROGERS BROS. CORPORATION  
ALBION,  
PENNA.



In today's war production set-up, even the saving of fractional manpower for servicing grease cups and oil fittings is important. And neglect of this attention can mean serious damage to irreplaceable production equipment. This can't happen with Wisconsin Engines because there are no grease cups or oil fittings; no lost manpower; no chance for human error or carelessness. Wisconsin Engines are protected by positive force-feed and splash lubrication.



**WISCONSIN MOTOR**  
Corporation  
MILWAUKEE, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines



### Plan Now POST-WAR SAFETY Include TUTHILL GUARD RAILS

PLANNING your Post-War Highway Safety Program logically includes specifying the TUTHILL GUARD RAIL. It prevents frequent accidents by being more plainly visible due to its convex surface. It saves lives and reduces damage. It deflects impacts—cushions shocks. Stands up, looks better, stays on job longer. Write for detailed specifications.

Pacific Coast Manufacturers and Distributors  
U. S. SPRING & BUMPER CO., LOS ANGELES, CALIF.

**TUTHILL SPRING COMPANY**  
761 POLK ST... CHICAGO 7, ILL.



## PROTECTION

Through American ingenuity and foresight troop movements are now protected from serious dive bomber attacks through the use of small captive balloons.

Mechanical foresight plus engineering genius has also protected certain types of Owen Buckets against the destructive action of the especially difficult conditions under which they are required to work.

**THE OWEN BUCKET CO.**

BREAKWATER AVE., CLEVELAND, O.

BRANCHES: New York, Philadelphia, Chicago, Berkeley, Cal.



# OWEN BUCKETS

ROADS AND STREETS, December, 1943



# HERE'S HELP FOR CONTRACTORS AND ENGINEERS



## WOOD ROAD-MIX *ONE-PASS* MIXING will boost production and cut completion time on *any* paving job—

When you get better than 2000 tons of mix per 8-hour day in *ONE PASS*, you get your job done quicker, with less manpower and less equipment.

That's how Wood Road-Mix methods of pavement construction, utilizing the Wood Roadmixer, are helping contractors and engineers in these days of labor and equipment shortages.

Employing the traveling plant method of pavement construction, the Wood Roadmixer delivers highest production of emulsion, road-oil or soil-cement mix

in *ONE PASS*. Yet two men, a tractor and a binder supply truck can handle the average job.

*ONE-PASS* mixing is the secret—no passing and re-passing. Wood Roadmixer's synchronized travel speed and mixing action, plus accurate binder volume control have made this pioneer equipment the world's leading, low-cost mix-in-place method of pavement construction.

If you want help *now*, write for bulletin and prices on the Wood Roadmixer.

*Dealerships for this popular roadbuilding equipment are now available to qualified dealers. . . . Write for particulars.*

DESIGN FOR ROAD-MIX



Write for detailed and illustrated Wood Roadmixer bulletin, "The fastest method of low-cost paving"

# WOOD ROADMIXER

Wood Manufacturing Co. • 816 West 5th St., Los Angeles 13, California

## A SUPER FRAME FOR A SUPER TRAILER!



Here's a trailer frame that isn't going to sag. It is extra heavy, and well braced. Beams are deep and have wide flanges and more cross members are used for rigidity. It gives you strength without added weight. Jahn Trailers have built up an enviable reputation for load carrying ability and freedom from frame troubles. This can easily be checked by contacting the hundreds of Jahn Trailer owners throughout the country.

You probably are making plans for the future. Let us send you the new Jahn Trailer Catalog to help you.

**C. R. JAHN COMPANY • 1345 W. 37th Pl. • Chicago**

Any Axle  
or  
Wheel  
Combination



"COME TO TRAILER HEADQUARTERS"



One  
man  
SPREADER

### For SEAL COATING and ICE CONTROL with fewer men at less cost *The FLINK Spreader*

The Flink self-feeding spreader is strictly a one-man outfit. Operated by driver of cab, who can throw spreader into action as he rapidly approaches, crosses and leaves intersection. Then it can be thrown out of action. Flink spreads forward or backward, full width of street, or less than half width. Handles sand, cinders, etc., up to 1" in size, wet or dry, spreading evenly up to 35' width. Does not limit use of truck for other purposes as Flink spreader fits on end as a tail gate. Positive agitation, no bridging. Flink spreader will pay for itself many times over the first year in labor saved, in extra yardage covered and reduction of complaints.

**The FLINK CO., STREATOR, ILLINOIS**

For particulars write our nearest representative:

**WICO SALES WISCONSIN OIL & EQUIPMENT CO.**  
2924 N. Western, Chicago 18, Illinois 34 Park Ave., Oshkosh, Wis.

**G. W. CLEMENTS**  
3050 Fremont St., Columbus 4, Ohio



**WHEN THE WAR IS OVER**  
BYERS will offer you new, improved, faster, mobile shovels and cranes for peacetime jobs...and you'll get them

In the meantime, owners of current and older models of Byers shovels and cranes may depend on Byers Parts Service to help them keep present equipment working steadily and satisfactorily.

### WHEN THE WAR IS WON

Byers will offer you new, improved, faster mobile cranes and shovels for peacetime jobs.

**BYERS** **CRANES AND SHOVELS**  
RAVENNA, OHIO  
DISTRIBUTORS THROUGHOUT THE WORLD



## A TOUGH ROLLER FOR TOUGH JOBS

**PIERCE-BEAR 2 - 5 TONS, VARIABLE WEIGHTS**

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The winning of "E" awards by the leaders of American Industry is not merely the result of an ability developed under the pressure of war. The achievement that merits such a recognition as an "E" award is the result of the years behind American Industry, the experience, the ability to organize, the desire to produce and get things done, the incentives of the good things of life that only effort, brains and the freedom that is American could make possible.

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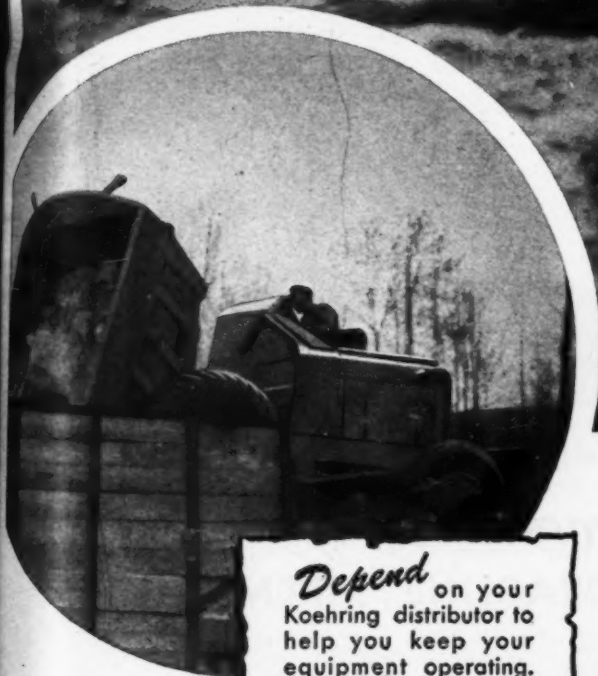
The lessons of initiative and ingenuity taught and learned during American Industries' development are today the potent weapons of wrath that are proving to our enemies the invincible strength, decency and comfort in the American way!

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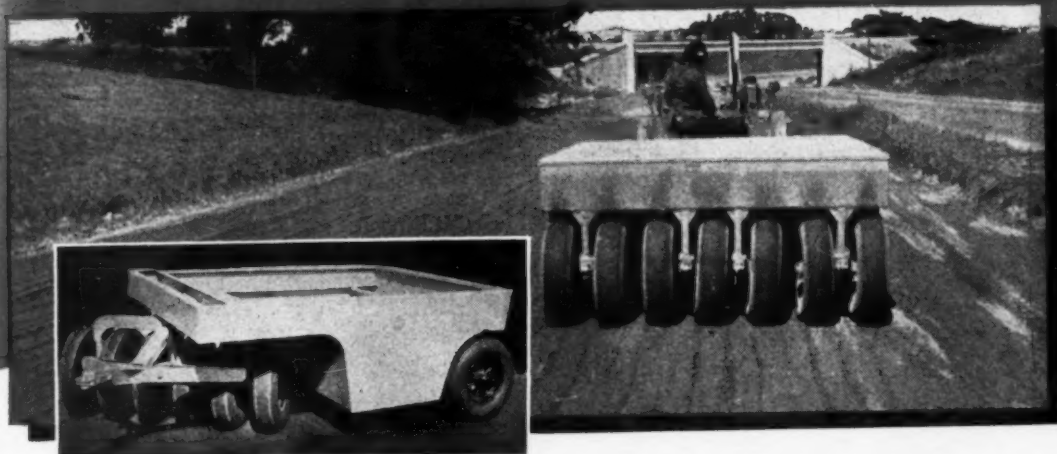
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Wobble-Wheel Rollers are building important military and commercial air fields both here and abroad.

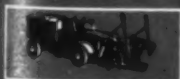
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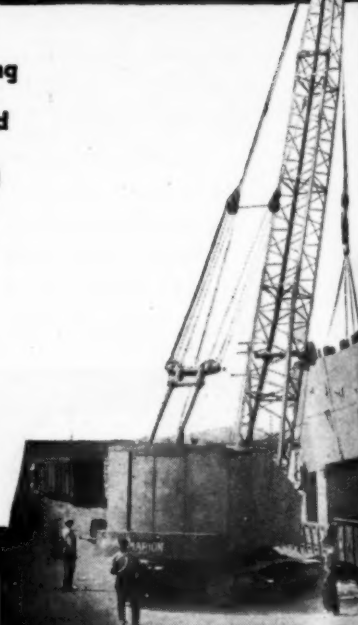
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The Future Of Material Handling!



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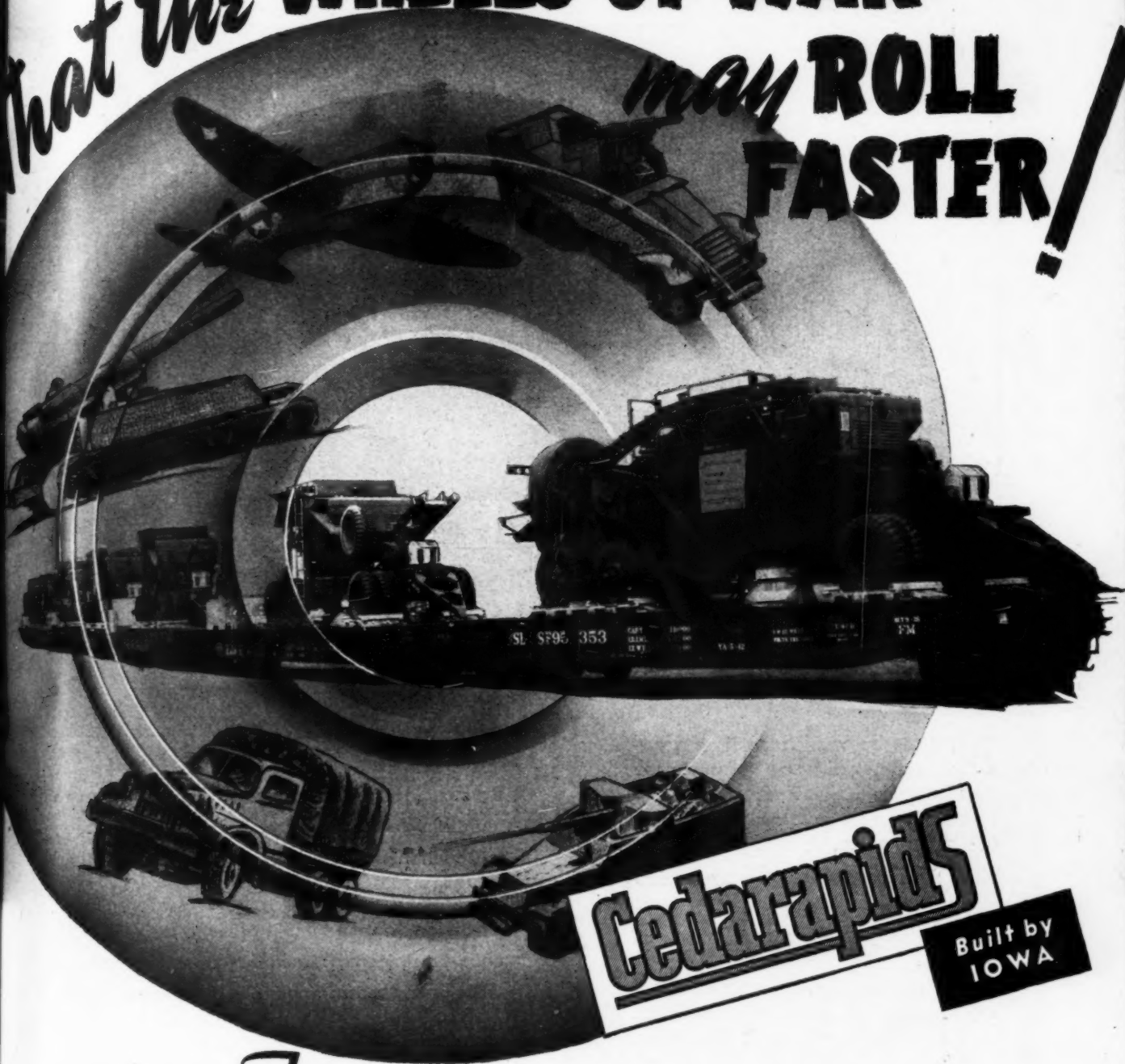


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# That the **WHEELS OF WAR** may **ROLL FASTER!**



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**T**HEY DIDN'T GO "foot slog, slog, slog, slogging over Africa" when Rommel was on the run. The man with the trucks got there "first with the mostest!"

Trucks, planes — all wheeled equipment moves over roads — this is a modern mechanized war and to beat the enemies we have takes the best.

Wherever there is action you'll find a Cedarapids crushing plant pouring out aggregate that the wheels of war may roll faster.

But there is something more than that coming out of the wartime construction and operation of machinery. The performance of a crushing plant under the press of war service can teach valuable lessons for peacetime operation.

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**B**ECAUSE he was properly geared-up in times of peace, your Cletrac distributor and members of his shop and field forces are making an important contribution to the war effort. More than ever, he is placing service ahead of sales—and is ready to assist you keep your Cletrac equipment "fit to fight."

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- 1 By supplying trained, expert service men to maintain and repair your Cletracs so that they will continue to provide dependable, economical performance.
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**CLETRAC CRAWLER TRACTORS**  
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# ROADS AND STREETS

December, 1943, Vol. 86, No. 12

## Long Concrete and Steel Bridge Raised 10 Feet with Gantry and Jacks

200-ton deck slabs and four continuous truss spans were lifted to clear backwater of TVA dam

**N**O man by taking thought can add a cubit to his stature, according to the ancient precept; but a bridge can be "stretched" (for that is what we really mean when we talk about bridge raising) and quite a few cubits added to its height. What made this job difficult and fascinating is that it involved not merely building an addition or lifting a structure, but increasing height without fundamentally changing its design or function.

We were given such a job to do by TVA on Walters Bridge, carrying U.S. Route 25E over the French Broad River, Tennessee. Contract was to raise this bridge and its approaches 10 ft. in order to span the

By C. D. HAXBY

General Superintendent, The Rust Engineering Co.,  
Pittsburgh, Pa.

higher water levels to be caused by closing Douglas Dam and consequent backing up of the river. We approached the job with the advantage of previous experience gained in raising a lighter bridge at Guntersville, Alabama.

Walters Bridge was originally 1,709 ft. long, including approaches. It was supported by 19 concrete bents under the approaches and four river piers. The approach deck comprised concrete slabs 36 x 24 ft. each weighing about 200 tons. A continuous truss spanned the river. More than

half of the bridge length, supported by 15 of the 19 bents, was comprised in the approaches on the northern side of the river.

### Novel Method on North Approach

Although work was begun simultaneously along the length of the bridge, a description may be best divided into separate discussions of the three different techniques used respectively on the northern approaches, the truss over the river, and the southern approaches.

The most original of these methods, and the one enabling completion of the job within the comparatively short schedule and with great economy both in labor and materials, was



Up she goes! The first slab on the Walters Bridge job is being lifted by the 200-ton gantry especially designed for this type of work





Walters Bridge, looking from the northern end. Gantry crane is shown in position to raise first slab which abuts hillside

employed on the long northern approach. It was based on the use of a gantry crane. This crane, unusually strongly built and designed by us especially for bridge raising work, had a capacity of 200 tons. It was operated with large drums, 2 ft. in diam. and 4 ft. long, having a very slow line speed of 20 f.p.m. on the drum. Indicators on the drums marked the loads, the danger point being 110 tons for each hoist. The crane's bases were set on tracks running parallel with each side of the approach; and its lifting work began with the northernmost slab, which was handled as follows:

Two holes were cut in each end of the slab, through which lifting beams suspended from the hoists were fastened, being secured against the concrete beams of the under part of the slab. Bolts were cut, reinforcing, dowels connecting the slabs were chipped down and cut; and the slab lifted to the desired 10 ft. additional height. The strength of the crane was such that several connecting rods which had not been located previously were sheared in the lifting process without any appreciable strain.

Heavy braced framework of 12 x 14-in. timbers meanwhile had been built beneath the slab. As the slab was raised to the new elevation, additional framework, based on the first framing, was swung beneath the slab at both ends and braced, propping the slab securely at its new height.

#### Piers Raised 10 Feet

With this slab now elevated to its new permanent position, forms were built and concrete placed for the 10-ft. upward extension of the northernmost bent, which abutted a hillside. This extended bent supported the northern end of the elevated slab when the wood supports were removed.

A similar process was employed at each panel working north to south along the northern approach. The second slab was lifted by the gantry, in the same way, and secured on wood frames. This permitted the building of a form and extension of the concrete bent which had supported the southern end of the northernmost slab and the northern end of the adjoining slab.

Bents supporting adjoining slab ends have tops with two different levels. The lower level forms a shelf on which the rollers of the more northern of the two slabs rest, while the upper level carries the flat surface end of the adjoining slab. In extending the bents, the two levels were evened off before the pour, and again reproduced at the new tops of the bents. Dowel holes for reinforcing rods were drilled in the heads of the original bents. In resetting the rollers in their plates on the lower shelf, where alignment is held by a pin and hole arrangement, the plates were leveled to an exact lie by simulating with grout. This had been unnecessary in original construction where the slabs were cast on top of the rollers. On the upper head of

each bent where the flat-setting end of the slab rests, cavities were cut in both bent and slab and filled with grout to give a stronger bond.

The above details are cited as typical of the numerous small problems and complications for which solutions had to be devised on the job, since its unusual nature provided scarcely any precedents.

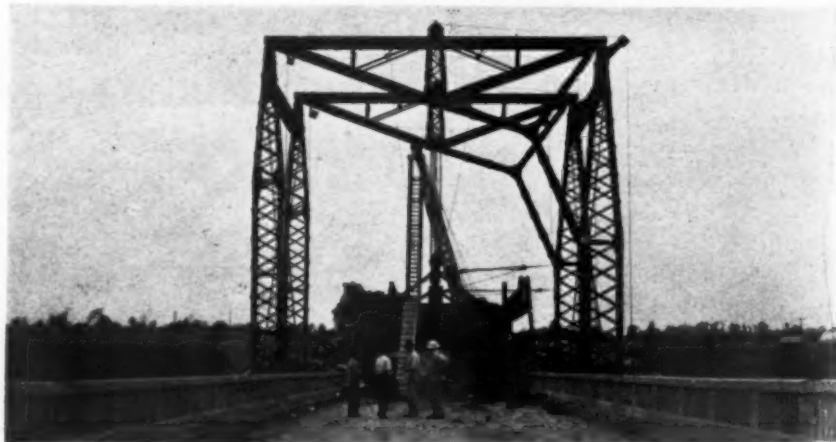
#### Jacks Used on Two Slabs

The procedure of lifting slabs with the gantry, and casting concrete bent extensions was continued on the northern approach until reaching the last two bents nearest the river. Here, due to difficulties in maneuvering the crane, the lifting of the slabs was undertaken by jacks set on timber cribs. This represented the second of the techniques used in the bridge raising job, and the one referred to as being used on the much shorter southern approach, which could be handled in this manner while the crane was working on the northern approach.

The contrast between this crib-and-jack method and the gantry crane operation amply illustrates the substantial advantages of speed and saving of labor and time gained by the use of the crane.

After some experimentation, we developed what was an ideal crib arrangement for our purpose, giving unusual strength to the pile supporting the jack and the slab above it. Four 8 x 8-in. beams are laid in a square, their ends slightly overlapping. Then two beams set close together are laid crosswise over the center of the square, both east and west, and north and south. On the intersection of these beams—the center of the cribbing—the jack is set, giving an unusually strong balance and distribution of weight.

In lifting the slab, the jack itself did not come in direct contact with the slab. Instead, the beams of the



With the first slab safely resting on wood framework which has been swung underneath it, the gantry moved on to the second slab

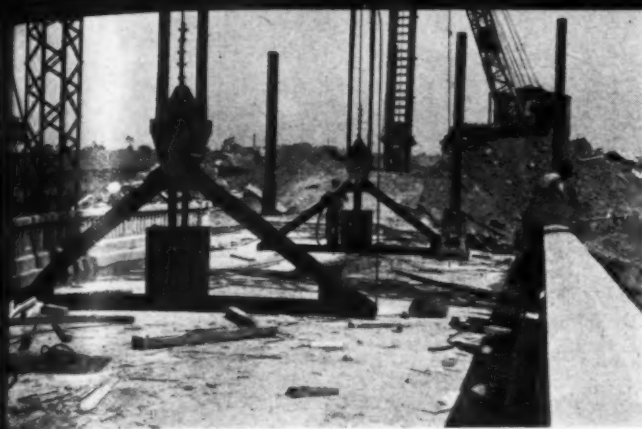


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The lifting beams of the gantry as they appear on top of the slab. Holes have been cut through the concrete at each end of the beam, through which the beams are secured against concrete beams under the slab



Gantry set for lifting first slab. The timber framework, on top of which additional supporting framework will be swung to support the slab, is clearly shown. At left, note two-level pier seat, lower side carrying expansion roller

slab rested on I-beams which were bolted to a jack beam extending up between the slab beams. When a sufficient height had been reached, new cribbing was inserted under the I-beams, after which the jack could be lifted.

Four jacks of 60-ton capacity each were used per slab in this operation, two at each end. When the slabs reached the desired height supported on the cribbing, the extension of the bents was cast as already described.

#### Piers Previously Enlarged

Before discussing the most ticklish part of our job over the river, it should be mentioned that before our starting the work, a preliminary job had been done by TVA engineers to give the bridge the necessary stability to carry its greater height. This consisted of fitting the piers with forms and enlarging them by pouring an additional layer of concrete. It is interesting that the extra thickness was continued only a foot below ground or water level, on the principle that stability is a function of the weight in the lower portion of a supporting column rather than of the anchoring at its foundation.

#### Lifting 4 Continuous Spans

Raising of the river portion of the bridge presented the problem of lifting a continuous truss resting on four piers. This could not be handled by sections as the approaches were, but must all be raised at once. In our actual execution, not more than one-fourth inch variation was allowed in any part of the truss, the elevation being constantly checked against measuring rods rising from each pier and equipped with markers which gave at a glance the exact height of the bridge at every moment above each pier.

Hydraulic jacks were again utilized for this work, two 150-tonners on each of the end piers and two 300-tonners on each of the two central



Although this photo is somewhat dark, it shows the under part of the lifting beam, lifting against two longitudinal beams of the slab. Note rollers at slab end

piers standing in the river. Two pumps, manned by two workers each, were required to operate the 300-ton jacks, the pumps being located on the bridge floor above. The weight of the bridge was carried by the jacks on jack beams, framed in across the lower steel work over the piers, and which remain as a permanent part of the bridge.

#### Special Cribbing Details

As the lifting process went on, cribbing was built up under the bridge shoes and the jacks. Concrete cribs, with two reinforcing rods extending 8 in. at each end, cast to maximum exactness in steel forms, were used. These cribs represented another development for use on this job. Not only did these cribs secure unusual accuracy; but they had the advantage of permitting, at every 2½ ft. in elevation in the lifting process, a pour of concrete to be made right over the cribs, the cribs thus becoming incorporated in the pier extension. The weight of the lifting was carried by the cribs within the new concrete while it was being poured and setting. This cribbing structure was topped,

when the desired height had been attained, with a concrete block with slots for bolting to the bridge shoe; and new concrete was then placed even with this block.

In the above process, necessary accuracy was assured by placing a sheet of lead between each layer of concrete cribbing to take up any unevenness.

At the two outer piers at the river edge, an interesting expedient was used with supporting steel braces, running at such an angle against the pier tops that they would have tended to sheer off the new concrete if maintained in this position. Being attached by a single bolt, the braces were pushed aside during the process of raising the bridge, and then kicked back in place at the conclusion of the rise.

#### "Drift" Created Emergency

To illustrate again some of the difficulties encountered in this type of project, it might be mentioned that our home office received a call during the lifting of the central truss reporting that part of the deck had "drifted" about 4½ in. downstream. Our superintendent could not identify the



A workman handling 300-ton jack on one central pier. The jack is lifting against a framed-in jack beam which remained part of the structure. Concrete cribbing remained, being incorporated in the concrete pour



A bridge shoe lifted above one of the river piers by the jack which is partly seen at upper right. Separate cribbing of precast concrete was built up under the shoes and jacks. Note reinforcing rods, cribbing and pier



Southern approach showing the slabs lifted 10 ft. on timber cribbing, and with the forms built for casting bent extensions. The left pier top and the point where cribbing starts shows original resting place of slabs

cause, unless it might have been prevailing winds; but the immediate urgency was of course to get it back. Recalling that in our earlier bridge raising a similar emergency had occurred, we were able to suggest the remedy. It turned out to be simple—merely lift the jack on the drifted side a bit higher and drop those on the other; and by manipulating in this manner, “juggle” the bridge back into position.

Besides the foregoing major considerations on the job, much routine work, including new approaches which extended the raised bridge some 50 ft. beyond its original length had, of course, to be done. Also many minor problems of interest cropped up. But the foregoing tells the main story.

#### Raising Saved Money

In addition to its interest as a problem, raising Walters Bridge merits discussion because of the definite economic benefit derived from this operation. The cost of the job, we estimate, at somewhat under half the cost of replacing it with a new structure. It also resulted in saving several thousand tons of steel in critical war times; and enabled the job to be done immediately without holdups which might have been occasioned by scarcity of critical materials for a new structure. The economy of the procedure used has been borne out by our becoming successful bidders for several additional TVA bridge raising contracts, figured on the same basis.

#### A.R.B.A. Convention Chicago, Feb. 1-3

Three major problems of deep concern to the highway industry profession will be treated at the 41st annual convention of the American Road Builders' Association to be held at the Edgewater Beach hotel, Chicago, Feb. 1, 2 and 3, according to Charles M. Upham, engineer-director.

In the program emphasis will be placed on the present highway transportation crisis caused by highway material and manpower shortages, on the A.R.B.A. Postwar Highway Plan, and on the postwar construction equipment problem.

“Never in history have the members of the Association been confronted with such a formidable array of problems,” Mr. Upham pointed out. Road and street builders must be united in their attack on each of them. A first step is finding out the facts, and that we intend to do. Authoritative speakers will represent both business and Government. Panel discussions and question-answer periods will assist in working out solutions.”

The back-orders for road and street construction and maintenance add up to needs more serious and general than most people realize, according to Mr. Upham. Every effort should be made to conserve the present supply of motor vehicles, yet poor roads and street surfaces are causing excessive damage to tires and are shortening the life of trucks, buses and passenger cars. Means must be found to make manpower available to the highway agencies and to obtain repair parts for construction equipment.

A related problem is that of postwar highway requirements. The backlog of highway needs is increasing so rapidly that the urgency of the Postwar Highway Plan of the A.R.B.A. is becoming more and more apparent. This 3-billion-a-year plan, first published last February, has been given general approval by civic, business and legislative leaders.

The third major problem is that of postwar construction equipment which directly affects every branch of the highway construction industry.

In addition, meetings of the Postwar Councillors and of the nine divisions of the A.R.B.A. will be held as will various committee meetings. The Old Timers Reunion is scheduled for Feb. 2, and the annual banquet Feb. 3.

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This recent photo taken on Archer Ave., Chicago, shows the superior durability of air-entraining portland cement concrete pavement. Pavement to the right and left of the car track is similar in construction except that the scaled pavement was built with normal portland cement, and the pavement free from scale to the right was built with cement produced by the same mill, but ground with an air-entraining material

## More About Air-entraining Cement

Research behind this important development; suggested specifications and construction procedure for concrete involving this cement

**C**ONCRETE having excellent durability as measured by its resistance to freezing and thawing and to the application of common salt or flake calcium chloride can be produced with air-entraining portland cements.

As noted in an article last month,\* this important fact has been demonstrated by test road projects in several states and by laboratory research. By air-entraining cements is meant portland cements with which minute quantities of certain air-entraining materials have been incorporated by intergrinding them with the clinker during the cement manufacturing process.

The following additional facts and comments are of timely interest, since scaling has developed in numerous localities on locations where heavy and frequent applications of salt have been made. The trouble naturally has been most in evidence on northern arterial roads and streets where officials have made the greatest effort to maintain safe traffic conditions throughout the winter months. Not all pavements have developed scaling. It has been at its worst around street car track switch points, at busy intersections, and at grades or curves where especially good traction is required at all times.

The age of the pavement at the time these applications are first made is a factor. Concrete pavements less than about four years old are much

more vulnerable than are pavements of greater age.

### Research in Progress Several Years

The scaling problem had long existed in some degree but the causes were not fully recognized. As early as 1928 extensive condition surveys of concrete highways in certain areas were made by the Portland Cement Association in co-operation with state highway officials. Similar studies were continued in 1933, the object being to determine the causes of pavement deterioration in order to prevent a recurrence in new construction. Conclusions from these studies had pointed to the necessity for careful selection of sound aggregates, care in proportioning the concrete mixture and supervision of finishing operations to avoid overfinishing.

With the increased use of ice removing chemicals, the Committee on Maintenance of the Highway Research Board\* issued recommendations to highway departments in 1933 to avoid using heavy concentrations of these salts. These recommendations were not generally observed, however, and after the abnormally severe winter of 1935-36 when chlorides were more generally used on pavements and in larger quantities than ever before, serious scaling was reported in many places.

A series of studies into the causes of scaling, begun about that time, has led to the present findings.

### Two Solutions Developed by Research

Since 1935 a comprehensive research program has been conducted to solve the scaling problem. Numerous agencies participated, including certain federal departments, several states and cities, portland cement manufacturers, and the Portland Cement Association staff.

One part of the work was to develop effective coatings for protecting existing pavements. Over a period of three years many materials were tried and hundreds of concrete specimens tested under a laboratory procedure which simulated field exposure, only was more severe and accelerated. Of the many protective coatings tried, commercial boiler linseed oil was most effective and soybean oil second. None of the bituminous materials tried provided satisfactory protection. Apparently the coating must penetrate the concrete to be effective. Nor did any other coatings tried give sufficient protection at reasonable cost. Where experience shows that treatment is desirable, the recommendation† is to give pavements two applications of boiled linseed oil (or soybean oil) thinned with naphtha, mineral spirits or turpentine, or an emulsified mixture of boiled linseed oil thinned with naphtha, kerosene, mineral spirits or turpentine.‡

†Detailed recommendations given in information sheet, "Protection of Existing Concrete Pavements from Salt and Calcium Chloride", published by the Portland Cement Association, Chicago.

‡Ohio state practice of applying 1/10 gal. of linseed oil-kerosene emulsion per sq. yd. on newer concrete pavements described in article, "Linseed Oil Treatment Against Scaling," by H. D. Metcalf, Sept., 1943, Roads and Streets.

\*"Scale-Free Pavements Made with Air-Entraining Portland Cement," by O. H. Gosswein, Nov., 1943, Roads and Streets.

\*Highway Research Board—Proceedings, 1933, part 2, p. 330-39.



### Scale Resistant Concrete Sought

However useful these findings, the big problem still was to develop a concrete which would have an inherent high resistance to salt and chloride action. That scaling can be prevented by using portland cements having air entraining properties has now been proved by further research. Some 20 major experimental projects totaling 83 miles in length in 10 states have been under observation since 1938.

Several resinous or fatty materials have shown the ability to impart air entraining properties to cement. Further studies may uncover other means of producing immunity to salt scaling, but meanwhile the present materials are available for immediate and effective use.

### Characteristics of Concrete Made with Air-Entraining Cements

Characteristics of air-entraining portland cement concrete require some changes in construction procedure. However, no radical changes are involved. The problem is the every-day one of adjusting construction procedure to the characteristics of the materials. Construction is not made more difficult or costly.

Freshly mixed plastic concrete made with air-entraining cements will have somewhat less weight per cubic foot than concrete made with the parent portland cement not containing air-entraining ingredients. For pavement mixes, best results will be obtained when the reduction in unit weight is not less than about 3 lb. per cu. ft. and not more than 6 lb. per cu. ft.

Concrete with excellent workability results from use of air-entraining cements. The plastic mixture has a fatty appearance, is cohesive and somewhat sticky, but is easily handled, screened and finished. Segregation and bleeding are reduced if not eliminated.

### Construction Suggestions

Cement handling calls for special precautions, since air-entraining cements are more fluffy and flow more

freely in bulk. All holes and cracks in storage bins should be plugged to avoid serious leakage. Batching equipment must provide for complete and positive shut-off to properly control cement content.

Separate containers for cement are preferred in hauling dry batches to the mixer, or else divider plates and tail gate in the truck body must fit very tight. It will help, where the cement is placed loose with the batch, to locate the aggregates near the ends of the compartment, with the cement between, to avoid leakage between batches. Higher than usual divider plates are recommended. Cover the cement with aggregate, or cover batches with tarpaulins in transit.

### Mix Design

At least the same cement content per unit volume is recommended for air-entraining portland cement concrete as compared with normal paving mixtures. Flexural strengths of air-entraining portland cement concrete may be from 10 to 15 per cent lower than that of normal concrete of equal cement content. This still leaves ample strength for structural requirements of pavement slabs. In designing the mix, consideration should be given to the increased volume of mortar resulting from the bulking effect of the entrained air. Bulking plus increased workability permits some reduction in the amounts of sand and water as compared with normal portland cement concrete mixes. A reduction in the batch weight of the sand by an amount equivalent to about 3 per cent of the total weight of both sand and coarse aggregate should, under average conditions, very closely compensate for the entrained air. This reduced amount of sand and about  $\frac{1}{4}$  gal. less mixing water than normally used per sack of cement are suggested for incorporation in the first trial batches.

### Mixing, Placing, Finishing

The usual 1-minute mixing time is adequate for thorough mixing of con-

crete made with air-entraining portland cements. Inadequate mixing will not permit entrainment of sufficient air in the concrete; and conversely, prolonged mixing is unnecessary and may in some instances tend to increase the entrained air beyond the limits desirable for adequate flexural strength.

In most cases advantage may be taken of improved workability by reducing the water content without impairing placeability. Since the concrete is almost free from sedimentation or bleeding, there is little free water on the surface during finishing operations. This makes it necessary to finish without delay, or else drying will harden the surface and hinder workmanship. The absence of free surface water is more critical on hot, dry or windy days. After operations have been adjusted to the material, this characteristic offers distinct advantages. Finishers are able to follow closely behind the mixer, long waits and overtime at end of the day are avoided, and early protection and curing are permitted.

Under some conditions air-entraining portland cement concrete, being more sticky than normal concrete, may adhere to the screeds of the finishing machine and cause a "torn" surface. When this occurs, it may be overcome readily by increasing the transverse oscillations of the screed in relation to its forward motion. Six to eight complete oscillations per foot of forward travel have been found to produce good results.

For hand-finishing, steel or steel-shod floats have, in some cases, given better results than wooden floats. All hand-finishing operations should follow closely behind the finishing machine.

### Specifications for Air-Entraining Cements

Air-entraining portland cements may be specified by the buyer by using the American Society for Testing Materials "Emergency Alternate Specifications for Portland Cement", ASTM Designation: EA-C150, which

Note how close the finishing equipment follows this paver when air-entraining cement is used. Scene on the new Philadelphia Industrial Highway late in 1943. Finishers have to learn to work with less surface water when air-entraining cement is used.



## Developments on Postwar Front

under Paragraph 3(b) provides for the addition of Vinsol resin to portland cements of Types I and II during grinding, in amounts of not less than 0.025 per cent and not more than 0.045 per cent by weight of the cement. Similar provisions for the addition of Vinsol resin during grinding are included in the "Emergency Alternate Federal Specifications for Portland Cement", Designations: E-SS-C-191b corresponding to ASTM Type I and Designation: E-SS-C-206a, corresponding to ASTM Type II.

### AED Annual Meeting January 17 to 20

The Associated Equipment Distributors, international association of construction machinery dealers, will hold its 25th annual meeting at the Edgewater Beach Hotel, Chicago, Jan. 17 to 20 inclusive.

Since it was founded in 1920, originally as National Distributors Association of Construction Equipment, the AED has grown from a charter membership of a few firms to a present roster of 500 distributors and nearly 150 allied manufacturers. The association has members throughout the United States, Canada and Mexico.

The annual get-togethers, especially during the current year, have afforded the members of the industry and representatives of government agencies an opportunity to discuss mutual problems in open forum.

Such meetings have been a means of guiding the industry in the substantial part it has played and is playing in the prosecution of the war.

Nationally prominent speakers are being arranged for by the program committee, under the chairmanship of AED Vice-President F. B. McBath of Portland, Ore.

Paramount problems of the industry, such as disposition of surplus government-owned construction machinery, contract termination and tax complexities, will be discussed.

Instead of the usual three-day meeting, the 1944 convention will be for four days—Monday through Thursday. The final meeting of the 1943 directors will be held on Sunday the 16th and the new 1944 board will meet Friday the 21st.

AED President Ed. P. Phillips of Richmond, Va., will preside over most of the sessions.

### Purdue Men and Road Work

Several Purdue University 4F engineering students have been working part-time for the Indiana highway commission to help meet the shortage of young men on surveying and other preliminary work.

The Chicago Plan Commission has recommended to the city council the construction of seven additional highways in Chicago after the war. These roadways would have right-of-way 300 to 330 ft. wide and cost about 232 million dollars. The commission emphasized that these roads must be either elevated or depressed and that every citizen must insist that they be built that way, since the day of street-level express highways in thickly settled districts is over.

Postwar road, street and bridge programs totaling more than 400 million dollars are being planned in Michigan, and surveys and plans have been completed on about 10% of the projects according to a preliminary report submitted to the state planning commission by state highway commissioner, Charles M. Ziegler.

Included in this grist of work is 219 millions in improvements programmed by 74 counties and 115 millions from 48 different cities. The state as of Dec. 1 had a planned program covering 70 million dollars of work, over half of which is in the "plans ready or nearly ready" stage; 8 millions' worth can be advertised on short notice.

New Jersey citizens are going to see big highway activity some day according to plans sent to the governor by Commissioner Spencer Miller, Jr. The commissioner's 62-page report covered 200 million dollars for reconstruction of existing highways, and added improvements on 600 miles of road legislated into the state system but not actually taken over.

The Indiana highway commission has been given approval to go ahead with the design and construction of the Indiana portion of the Tri-State Highway. The proposed highway through the Calumet area, which would link Indiana with continuing roads in Illinois and Wisconsin, and eventually Michigan, and would cost an estimated \$9,875,000, and is one of the state's major postwar projects. There would be 17½ miles of dual concrete road with provision for additional lanes, and 8 railroad and 12 street or highway grade separations. Right-of-way to be 300 ft. wide.

Surveys for 40% and plans for 20% of Illinois' proposed 100 million dollar postwar program have been completed according to Wesley W. Polk, chief highway engineer. The program includes 110 miles of 4-lane, 701 miles of 2-lane, and 66 miles of

variable-width pavement, 75 miles of medium-type surfacing, 115 miles of grading, 100 railroad grade separations, and 165 bridges. An additional 3 million dollars of improvements covering 160 miles of secondary roads is contemplated.

All of Route 66 between St. Louis and Chicago will be made 4 lanes wide, 65 miles already having been completed, and approval is sought for 4-lane construction on U. S. 40 entirely across the state.

What future population trends to base postwar highway planning upon is a critical problem in California according to an analysis by E. E. East, chief engineer, Automobile Club of South California, in a paper before the ASCE, Los Angeles section. Some predictors look for 39 million population by 1960, with 6 million motor vehicles in the state within a few years after the war.

A \$47,600,000 annual state highway program in Missouri, to be financed with \$17,600,000 in local funds and \$30,000,000 of anticipated federal funds, is seen by C. W. Brown, chief engineer.

On the basis of 1941 revenue, funds available for highway ward derived from local sources will be \$29,000,000 annually after the war; \$11,400,000 available for highway work derived will be required to pay the cost of bond retirement and interest charges, operation of the state highway patrol, administration and overhead charges. This will leave \$17,600,000 available for maintenance and construction. Proposed federal legislation setting up a \$1,000,000,000 a year would give Missouri an additional \$30,000,000.

Needed postwar highway improvements in Wisconsin will aggregate \$115,000,000, announced E. L. Roetiger, state highway engineer—\$86,000,000 for work on the state and federal trunk road system, including \$10,000,000 worth of urban street work; \$15,000,000 for additional urban needs in arterial and distribution routes; and \$15,000,000 for modernization of 2,500 miles of county roads.

Surveys and plans for primary construction or reconstruction on the state trunk system authorized to date total 920 miles, with 253 more miles pending authorization. Survey has been substantially completed on 486 miles and survey is in process or about ready to start on 434 additional miles of road. Plans are almost complete on 315 miles and in process on 81 miles.



# Tractor Trains at 70° Below



All photos by Richard Finnie for the U. S. Engineers, Northwest Division  
Bulldozers and angledozers were the main trail-breaking tools. Note the small trees, which were easily pushed over in clearing

## Canol's Roads and Trails

\$138,000,000 construction job being pushed by U. S. Army engineers and American contractors in northern Canada

By HAROLD J. McKEEVER  
Editor, Roads and Streets

ONE of the great engineering feats of the continent, and probably the most far-flung ever undertaken, geographically speaking, is the Canadian oil development project known as Canol. Although initiated early in 1942 when the decision to build Alcan Highway made it feasible, Canol was shrouded in secrecy until recently. But now it is known that subarctic oil wells are being drilled along the MacKenzie River, that 1,600 miles of pipe line is under construction across northern wilderness, and that the project involves a refinery, a 1,200-mile transport system along streams and lakes, a 1,000-mile winter trail and many hundred miles of roads.

"Fact is," explained one of its builders, "Canol is mostly a road building job." It is also one of the reasons for the existence of the Alaska Highway, as testified by the constant stream of trucks headed up Alcan all through 1943 with Canol-bound pipe, machinery and camp supplies. Airports, too, figure in this gigantic

undertaking, as in every large enterprise of the region.

### "Why" of the Project

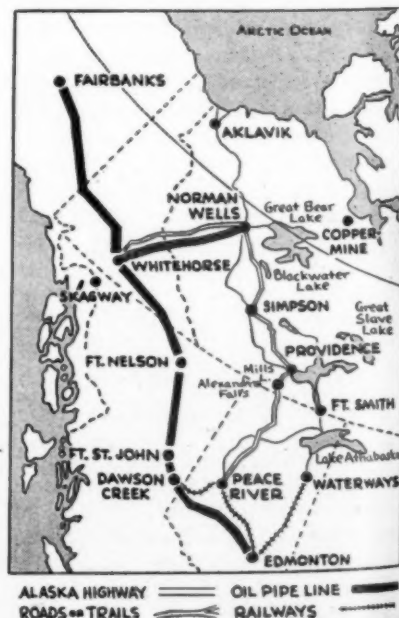
A few oil wells had been in production for a number of years in the Fort Norman region along the lower MacKenzie. Further development has been slowed by the fact that Fort Norman is more than a thousand miles north of the nearest railroad. But Fort Norman also is only 700 air miles east from Fairbanks, and when war in the Alaskan theater brought a sudden demand for huge supplies of gasoline and other petroleum products in that area, the U. S. War Department decided to tap this oil field in earnest and pipe the crude 600 miles over the MacKenzie mountains to Whitehorse on the Alaska Highway for refining and distribution.

Before oil could be pumped overland a complexity of tasks had to be undertaken. In May, 1942 contracts were let between the American government and the Imperial Oil Co., Standard Oil Company of California (producers and refiners), J. Gordon Turnbull and Svendrup and Parcel (architects and

engineers), and Bechtel-Price-Callahan (contractors). The U. S. Engineers took over direction and actively participated in construction, utilizing engineer troops seasoned by work on the Alaska Highway. The U. S. Ordnance Department made much equipment available.

The first undertaking was the movement of thousands of tons of pipe, machinery, fuel and supplies to Fort Norman, and by early in the summer of 1942 Engineer troops had headed north out of Edmonton. During the summer supplies began to be freighted north from the railhead at Waterways, via the Athabaska and Slave Rivers to Fort Fitzgerald, past rapids over a short portage, down the Slave River to Great Slave Lake, along the lake to the MacKenzie River, and down that River 550 miles to Fort Norman—nearly 1,500 slow miles from Edmonton! Freight moved down the rivers by army-operated pontoon rafts and prefabricated barges. At Fort Smith and Fort Fitzgerald army and contractor men built wharfs and improved roads and performed the difficult feat of portaging 2,900-tons of freight and many 100-ton, 150-ton and larger barges for 14 miles overland and launching again. Heavy-duty machinery trailers and heavy diesel tractors did the hauling, while bulldozers and trailbuilders carved, graveled and maintained a rough portage road.

During the 1942 summer other fleets of dozers, scrapers and graders hastily built runways and landing strips between Edmonton and Norman Wells,





to permit greatly enlarged, all-season air cargo operation. Aerial reconnaissance flights and flight-strip photos between Norman Wells and Whitehorse were made to establish the general path of the pipe line and parallel road, and a small beginning was made in construction of this road.

The Fort Norman-Whitehorse road was recognized to be one of the most serious undertakings, surpassing the Alaska Highway in difficulty. Passing over an almost unexplored and little mapped region, the highway line had to traverse 300 miles of permanently frozen ground, reaching a high altitude and skirting mountains all the way. Working westward from Norman Wells, the road had to rise from El. 300 ft. El. 1700 ft. in a distance of 36 miles out of the MacKenzie Valley. It was determined to push this road from both ends, and by the close of the 1942 season road building and laying of pipe eastward from Whitehorse was well under way, from several camps established in the Whitehorse area. By then, too, new big-producing wells had been brought in around Norman, storage tanks were under way and a pipe line built across the wide MacKenzie.

#### 1,000-Mile Winter Trail

With the 1942 winter freeze-up another phase of Canol began; that of greatly accelerating the movement of freight to Fort Norman over frozen trails by tractor and sledge and truck. This meant the hacking and bulldozing of a road or trail for a distance of 1,020 miles northward from the town of Peace River. The freight quota for winter hauling was set at 9,000 tons. An existing provincial road was utilized for the first 85 miles, and then an existing tractor trail on to the mouth of the Hay River had to be relocated

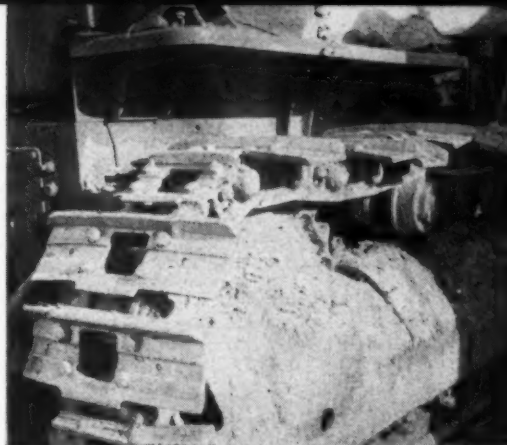
and improved and a cut-off built, the pioneering being done by U. S. army engineer troops with the contractor following, as in building the Alaska Highway. Bechtel - Price - Callahan men simultaneously headed south from the Fort Norman end with tractors, crossing uncharted wilderness and lakes in biting cold and living on emergency rations. Other crews broke trail from two intermediate starting points.

The trailbuilding procedure was simplicity itself. Where the path crossed frozen lakes or rivers, the tractors merely bucked and shoved loose snow aside to get to solid footing. On ordinary frozen ground the advance tractor operator headed in the general direction of travel, picking his way over hills and gullies. With angle or dozer blade he knocked over trees, brush and other growth, scraped loose rubble, cleared snow if not too deep, or smoothed and packed the snow otherwise. When the road wore out under the churning tractor treads, the machines would break new paths alongside.

#### Tractors Pulled 60 Tons

Close behind came the convoys consisting of tractor-drawn or semi-trailer sled trains. A tractor usually pulled two to four sleds, each carrying from 10 to 15 tons of cargo. Four or six-wheel drive trucks and half-tracks were also employed, being made into trailer units by use of pontoon trailers. The usual truck trailer sled load was 26,000 lb. According to superintendent George Anderson of B-P-C, in describing their experiences to the writer, 140 heavy crawler tractors were the mainstay in the trail construction and the freighting. He also paid tribute to their Linn half-tractors, which

(Continued on page 85)



Top: Notched ice grousers stood up best on the Canol winter trail hauling. Middle: Fresh air aplenty in this bedroom, consisting of a sleeping bag thrown down in the middle of the trail. Warmer than you'd think. Below: Repairing tractors in sub-zero weather. Several machines were damaged by too enthusiastic use of bon fires

Left: This isn't a string of railroad cars but a convoy of tractor and truck drawn cargo sleds. Right: Linn tractors acquitted themselves well pulling 60-ton trailer loads. All trucks were grossly overloaded, which, contrary to manufacturers' instructions, was of necessity a consistent habit on the Canol job





Three-truck test arrangement

## Assembly and Operation of Plate Bearing Test Equipment

**T**HE Airways Engineering Branch of the First Region of the Civil Aeronautics Administration, with offices at LaGuardia Field, New York, has been utilizing plate bearing tests in the preparation of air port paving design. Several interesting problems have been encountered both in assembling the apparatus required for the plate bearing tests as well as in the operation of the equipment in the field.

Wartime conditions, in connection with procurement of high-priority materials and equipment, made it necessary either to delay procurement until such time as a preference rating could be secured or to improvise with available used material. Mr. J. E. Cowles, Chief, Engineering Unit, CAA, who developed the equipment, met this problem by canvassing local materials houses, contractors and scrap metal storage yards.

### Items in Original Design

The equipment as originally designed consisted of a 24-inch I-beam, 18 ft. long which was to be loaded, as described below, and used as a reaction for the load to be applied to the bearing plates; a 5 in. I-beam 16 ft. long as a mount for the dial indicators; and three bearing plates 2 in. thick and 30, 24 and 12 in. in diameter, respectively, nested with dowels to prevent movement and equipped with handles to facilitate handling. In addition to the structural members, it was necessary to purchase dial indicators with mounts, a hydraulic jack with detached pump and pressure gauge, a chain hoist and other miscellaneous items required to construct a small stiff-leg derrick.

By H. K. GLIDDEN

Chief, Airways Engineering Branch, First Region, Civil Aeronautics Administration, La Guardia Field, New York

Shop fabrication consisted of welding a socket on the bottom flange of the 24-in. I-beam together with a complementary ball on the head of the jack and handles on the bearing plates. A 1½-ton stake-body truck was utilized for transporting the equipment to the various airport sites and a stiff-legged derrick was mounted on the truck body to enable the crew to load the heavy members readily. The derrick was constructed by Civil Aeronautics Administration personnel from timber, and necessary shapes picked up in storage yards.

The following table lists necessary materials, together with their approximate cost; as a used truck was

available for our purpose, the cost of a truck required for transportation is not considered herein:

Structural Members (fabricated).....	\$260.00
30-ton hydraulic jack, detached pump, pressure gauge .....	242.50
Ames Dials, surface gauge mounts .....	80.00
Chain hoist .....	75.00
Miscellaneous items for derrick....	45.00
Total .....	\$702.50

It was originally intended to apply the load by placing loaded trucks directly over each end of the 24-in. I-beam. This procedure was found to be unsatisfactory. In the first place, the Engineer in charge of tests experienced considerable difficulty in renting suitable heavily loaded trucks or trailers as, in most cases, the tests were made at the airport sites before construction began and heavy equipment was not always available. In the second place, a number of truck owners contacted were not willing to rent their trucks as they felt that



Fig. A. Four loaded trucks are being used as reaction to the jack



trucks might possibly be damaged by the concentration of a heavy load on one point of the truck frame. In addition, the same rental per hour was required for this use of their trucks as would be asked for normal hauling operations. Thirdly, this procedure required the construction of ramps of sufficient height off the ground so that the frames of the trucks would clear the 24-in. I-beam. These various factors reduced the tests to a slow and costly procedure.

### Ingenious Method Developed

In order to overcome the difficulties involved, eight expanding-type anchors were purchased with the

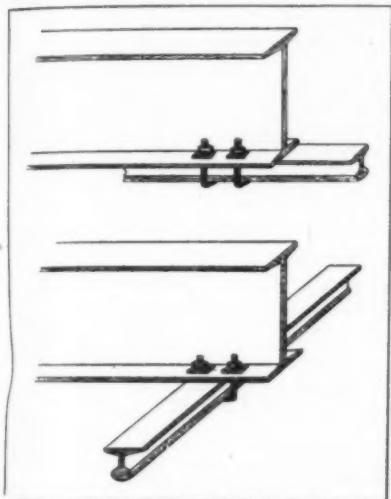


Fig. B. Attachment of track rail to end of main I-beam

thought that the anchors could be used as a reaction to the load imposed by the jack, but this was also found to be a slow and expensive process and not adaptable to all types of soil.

After the experimental stage was passed, we developed what we feel to be rather an ingenious method of operating the equipment and a standard procedure was set up subject to

variations as demanded by field conditions. It was found that the equipment could be operated without the use of ramps with either two, three or four loaded trucks, depending upon the gross weight of the trucks available in the vicinity. It was also found that four small trucks are easier to obtain than two heavier trucks.

The method finally adopted to allow the use of trucks in various combinations required the purchase of two 5-ft. lengths of heavy railroad rails, four heavy U-bolts and the drilling of four holes in the bottom flange of both ends of the 24-in. I-beam. As is noted in Fig. B, the holes in the I-beam can be so located that the railroad rail may be mounted on the bottom flange of the I-beam either perpendicular to or along the longitudinal axis, using the same U-bolt and holes. As is also illustrated in Fig. D, the two pieces of railroad rail may be attached either perpendicular to or along the longitudinal axis of the I-beam in accordance with the number of trucks to be used in the test. Fig. A illustrates the equipment being operated, using four loaded trucks as a reaction to the jack.

In the final position, the 24-in. I-beam is about 4½ ft. above the ground. The I-beam is securely clamped, raised by means of the stiff-leg derrick and placed on the jack. The trucks are carefully centered on the bolted railroad rails, blocked up with other railroad rails or timber blocking and "chocked" in to prevent any movement. A contact load is then applied by the jack, and the girder clamp is disengaged so that the derrick truck may be moved. The 5-in. I-beam is placed slightly above the bearing plate perpendicular to the longitudinal axis of the main I-beam and the indicator mounts attached.

It will be noted from Fig. C, that the smaller I-beam is carefully sup-



Close-up view of same beam setting as shown in Fig. C (see text)

ported on a plate and sandbagged down to prevent any possible movement or deflection of this I-beam. The supports for the smaller 5-in. beam are, in all cases, 8 ft. from the center of the bearing plate. This precaution is taken to secure against incorrect readings resulting from disturbances of the ground as pressure is applied to the plate. As will also be noted from Fig. C, the pump and pressure gauge used, are connected with the jack by a 15-ft. length of high-pressure tubing. This allows the jack to be operated without possible disturbances.

### 30-Ton Jack Used

It has been found that the 30-ton jack, employed, is capable of considerable overload, but it is planned in the near future to secure, if pos-

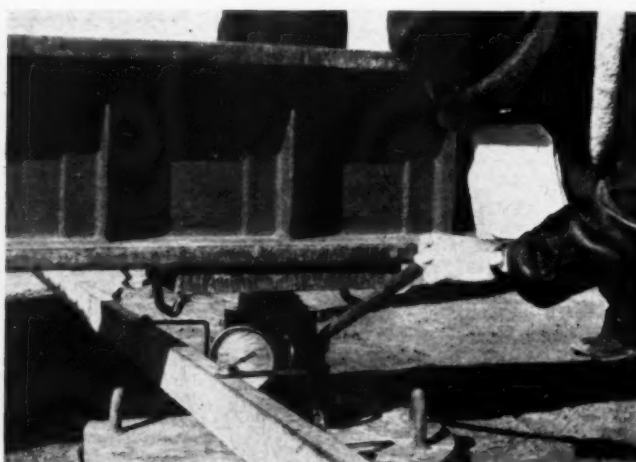
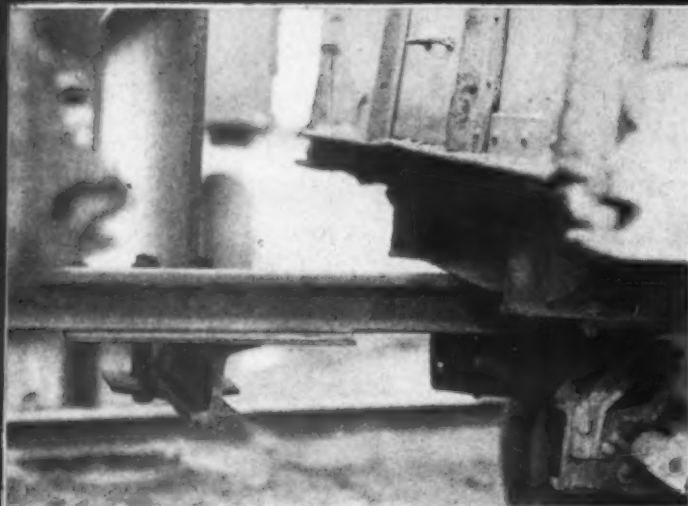


Fig. C (Left): Showing how smaller I-beam is supported on a plate and sandbagged down to prevent movement. (Right): Field load bearing test underway at Fort Dix airbase





These two views and scene below show beam and blocking arrangements used in plate bearing tests

sible, a 50-ton jack in order that data may be secured for designs calling for higher wheel loads. The connection between the jack and the 24-in. I-beam is a ball-and-socket joint, designed to avoid eccentricity in loading. Nevertheless, we have found that sufficient friction is mobilized in the ball point to cause unequal settlement of the plate; therefore, the deflection is measured by two diametrically opposed Ames Dials, bearing on the plate. After having set the dials under the initial seating load, the test load is applied in 5 lb. per sq.-in. increments and carried to at least 150% of the design load. To obtain a rebound curve, the load may be released in increments of from 5 to 10 lb. per sq. in. as appears desirable.

Test results are then plotted by the Engineer in the field and incorporated in a report submitted by him with such recommendations as he desires to make in connection with the airport grading and paving design.

#### First Test Application

The first assignment for the apparatus was at Chemung County, New York, Airport for the purpose of testing the bearing value of a soil-cement base course which had been allowed to stand throughout the winter, protected only by an application of seal coat. Later other assignments were made for the purpose of deter-

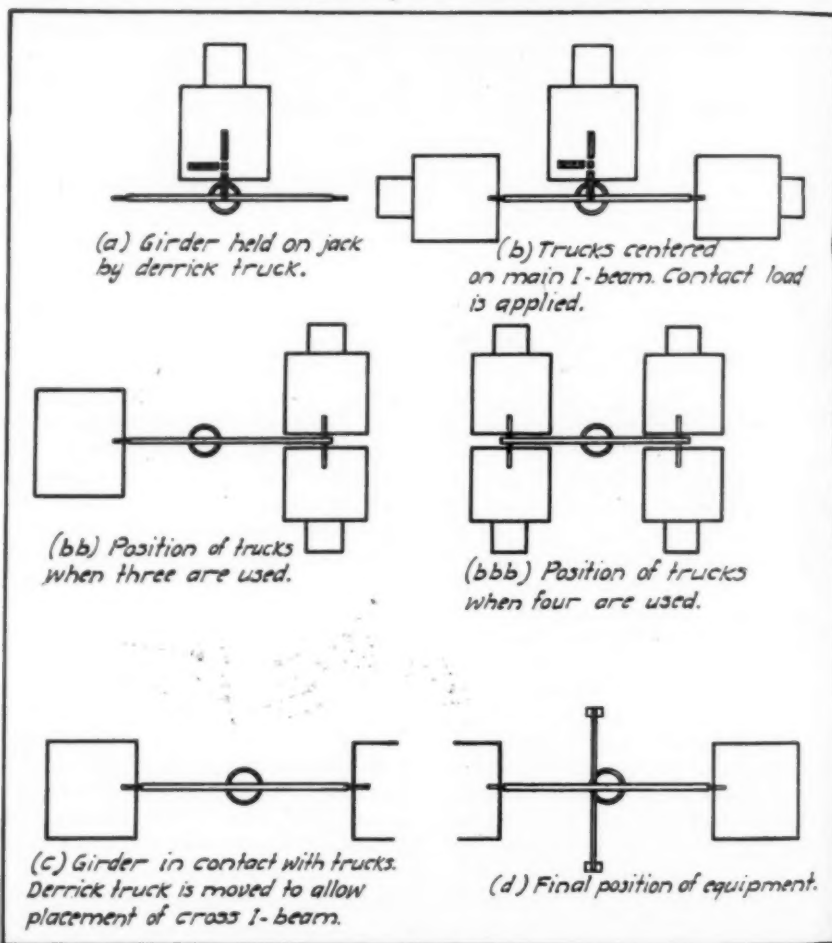


Fig. D

termining the bearing capacity of the subgrades preliminary to pavement design and checking bearing values of existing pavements.

We have found that, including the cost of the rental of the equipment required for loading the plates, the salary and traveling expenses of the operating personnel and the cost of transporting the equipment from site to site, each test cost approximately \$100. This figure will, of course, vary with the number of tests conducted at any one site, hourly rental rate prevailing for trucks, and the distance traveled from site to site. The data secured have been helpful

in preparing grading and paving design and in checking bearing values of pavements already installed.

Our experience has shown that the heavy equipment used in this test is dangerous even with the most careful handling. While not shown in the accompanying Figures, we have found it necessary to weld two cross members, each 2 feet long, perpendicular to the 24-in. I-beam and located at the top near each end, to guard against injury to operating personnel, by reason of the 24-in. I-beam falling over during such time as it may be standing on edge while not in use.



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# Highways and Bridges of El Salvador

*Smallest of the mainland American republics, El Salvador is one of the most progressive in all matters pertaining to highways and has the distinction of being the first to complete that portion of the Pan American Highway lying within its boundaries. The fact that the last 35 miles of the route is not technically the "Pan American Highway" but rather the "Pan American Highway Military Route" is of no significance, as it completes the connection with the Pan American Highway in Honduras, and will be used by the great majority of all Pan American traffic. The author was fortunate in being able to attend the dedication of this section on October 5 of this year. Among those present at the ceremonies, beside the engineers and officials in charge, were President Martinez, United States Ambassador Thurston and many other notables.*

**T**HE Dirección General de Caminos (Public Roads Administration) of El Salvador divides its road system into 3 main classes:

**1st Class.** Trunk highways, connecting the nation's capital with the various departmental (or state) capitals, ocean ports or the frontiers of the country.

**2nd Class.** Departmental (State) highways, connecting important points of any sort—cities, agricultural or industrial centers, tourist resorts, etc.—but not including any of the Class 1 highways.

By **JOHN C. BLACK**

Editor, CAMINOS Y CALLES

**3rd Class.** Regional roads, connecting towns, villages and points of lesser importance.

Decision as to which communities shall be rated as of major and which of minor importance rests with the national highway authorities.

Class 1 and Class 2 roads are constructed, maintained and improved entirely by the federal government through the Dirección General de Caminos. Class 3, regional roads, are a direct responsibility of the local governing bodies, but with the Dirección General maintaining technical and administrative control.

## General Requirements

The book of rules for highways, issued by the ministry of promotion and development in 1940, defines the three classes of roads explicitly and gives general specifications for the location and construction of each. In the specifications covering width,

grade, curvature, sight distance, etc., each class is split into an "A" group for level country and a "B" group, with less rigid restrictions, for mountain locations.

Provisions governing the more important road features are as in Table 1.

Superelevations for flat curves are designed for speeds of 30 miles per hour, and for sharp curves coming close together, 18 miles per hour.

Excavations in earth or loose rock are required to have slopes not less than 1 to 1; while in "talpetate" (a sort of hardpan) or solid rock,  $\frac{1}{4}$  to 1 slopes are permitted. Excavation in solid rock is carried 12 in. below profile level, and the space filled with approved material.

Where fills are to be made on natural ground having a slope steeper, than 1 vertical to 2 horizontal, it is required that the ground be loosened to a depth of at least 10 in., or cut in steps, before any fill material is deposited on it, in order to insure a proper bond.

Table 1

	Class 1		Class 2		Class 3	
	A	B	A	B	A	B
Max. Grade .....	6.0%	7.0%	7.0%	8%	10%	12%
Max. degree of Curve:						
(Metric System) .....	10°	20°	20°	30°	30°	40°
(U. S. System) .....	15°	31°	31°	46°	46°	62°
Min. width of Row .....	20 in. (66 ft.)	20 in. (66 ft.)	20 in. (66 ft.)	20 in. (66 ft.)	16 in. (52½ ft.)	16 in. (52½ ft.)
Min. width of Roadway .....	10 in. (33 ft.)	10 in. (33 ft.)	10 in. (33 ft.)	10 in. (33 ft.)	8 in. (26 ft.)	8 in. (26 ft.)
Min. width of Surfacing .....	6 in. (20 ft.)	6 in. (20 ft.)	6 in. (20 ft.)	6 in. (20 ft.)	5.5 in. (18 ft.)	5.5 in. (18 ft.)



Cuscatlan bridge which carries Pan American Highway over the Lempa River. Completed 1942

Photo by courtesy of Dirección General de Carreteras



The 12 Km. (7½ miles) of the Pan American Highway between San Salvador and Santa Tecla is paralleled by an earth road for animal traffic. It is planned ultimately to use this as right of way for the additional lane of a divided super highway.

Photo by J. C. B.

### Surfaces

Approved surfacings for Class 1 roads are asphaltic penetration macadam, asphaltic concrete, and reinforced portland cement concrete. Thicknesses are not covered in the general specifications, but up to date the penetration macadam has been constructed as a light surface course on an 8-in. or 12-in. water bound macadam base. It has stood up well, and is in generally good condition, but would, of course, suffer if subjected to a severe truck traffic for which it was not designed. The Pan American Highway, the road from the City of San Salvador to Zacate-

coluca and the road from Santa Tecla to La Libertad on the coast are paved with this type of surface. Other roads connecting important centers are surfaced only with crushed rock or gravel, but will be improved as funds become available.

Second class roads generally have surfaces of waterbound macadam, although an asphaltic carpet on a base of hardpan, coarse sand, gravel or crushed rock is permitted.

Roads of Class 3 are not generally surfaces of water bound macadam, alas and cheaply available.

All new bridges are designed for the H-15 standard loading of the

American Association of State Highway Officials.

### Pan American Highway

Predominant in importance—in fact, the very backbone of the country's road system—is the Pan American (Inter American) Highway. It begins at San Cristobal on the Guatemalan boundary, passes through the country's three largest cities—Santa Ana, San Salvador and San Miguel—reaches the Gulf of Fonseca at the port of La Union, and the bridge over the Goascoran River into Honduras at El Amatillo. The total length is 308 km, or 191 miles. This is for the original, or "official" Inter American Highway. Actually, the Pan American Highway Military Route, from San Miguel to the Goascoran bridge, begun in 1942 and finished in September, 1943, under direction of the U. S. Army Corps of Engineers, will be used by most vehicular traffic between El Salvador and Honduras or other countries to the east and south. By it the total length of the Inter American route in El Salvador will be 294 km. or 183 miles.

From Guatemala to San Miguel, a distance of 147 miles, the highway, being a Class 1 road, is paved with penetration asphalt 6 meters wide. The remaining 57 km to Goascoran bridge (the recently completed Military Route) has a finished width of 33 ft. between side ditches and a paved center section 16 ft. wide with from 6 to 9 in. of crushed rock on a 5-in. sub base of selected material. Presumably a penetration surface will be provided in the near future. Easy



Tunnel in "telpetate" on the Zacatecoluca road

Photo by courtesy of Dirección General de Carreteras



grades and curves prevail over the entire route from Guatemala to Honduras.

Improvement of the other road (the "old" Inter American route from San Miguel to La Union and thence to the Goascoran bridge) with funds from the U. S. Public Roads Administration and an advance from the Export-Import Bank, is now in progress and nearing completion. The length is 44 miles. Surface will be asphalt penetration.

### Other Roads

As mentioned in a previous paragraph, two other roads have good black top surfaces—the one from Santa Tecla to the port of La Libertad, about 16 miles, and the road from San Salvador to Zacatecoluca, about 37 miles.

Beside the San Miguel-La Union-Goascoran portion of the Pan American Highway, there is now under construction with Export-Import Bank funds, the San Salvador-Sonsonate-Acajutla road, about 47 miles long. It is a Class 1 route and will be given an asphalt surface.

Thus El Salvador's three ocean ports—Acajutla, La Libertad and La Union—will all have first class connections with the Pan American Highway, and so with the interior of the country.

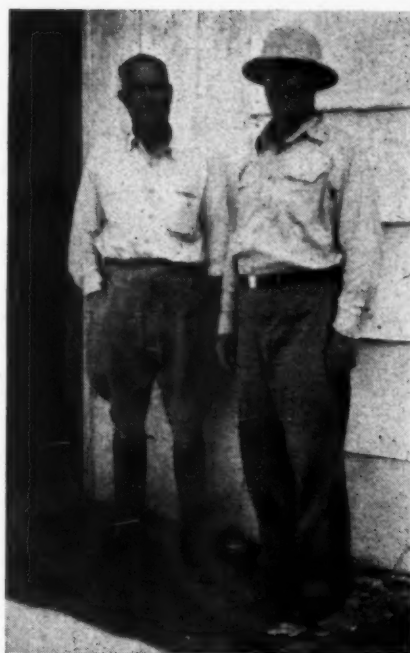
Next in importance to the highways already mentioned is the "North Road," leading out of San Salvador to tap an extensive back country beyond the Lempa River, and to provide an important connection with the western part of Honduras. The pres-

ent road, dating from colonial days, has reasonable grades and curvatures but a surface on which it is a shame to drive a decent car. Flat, wet ground and long stretches filled with large stones to keep traffic from going hub-deep are the chief faults. A new road, located on higher ground, mostly to the west of the old, will be constructed as fast as funds become available. In the meantime a \$1,000,000 suspension bridge is being built across the river at Colima with funds furnished by the Export-Import Bank. Until completion of the bridge, the river will continue to be crossed by ferry.

Regarding second and third class roads, not a great deal need be said. Many of the second class are in good condition for automobile traffic, being adequately surfaced with crushed rock or gravel. Some of the third class, also, can be used by motor vehicles in dry weather, although not constructed directly for that service. The network connecting population centers—minor as well as major—is quite complete, and the country's main highway activities can now be directed toward the improvement of grades, alignments and surfaces.

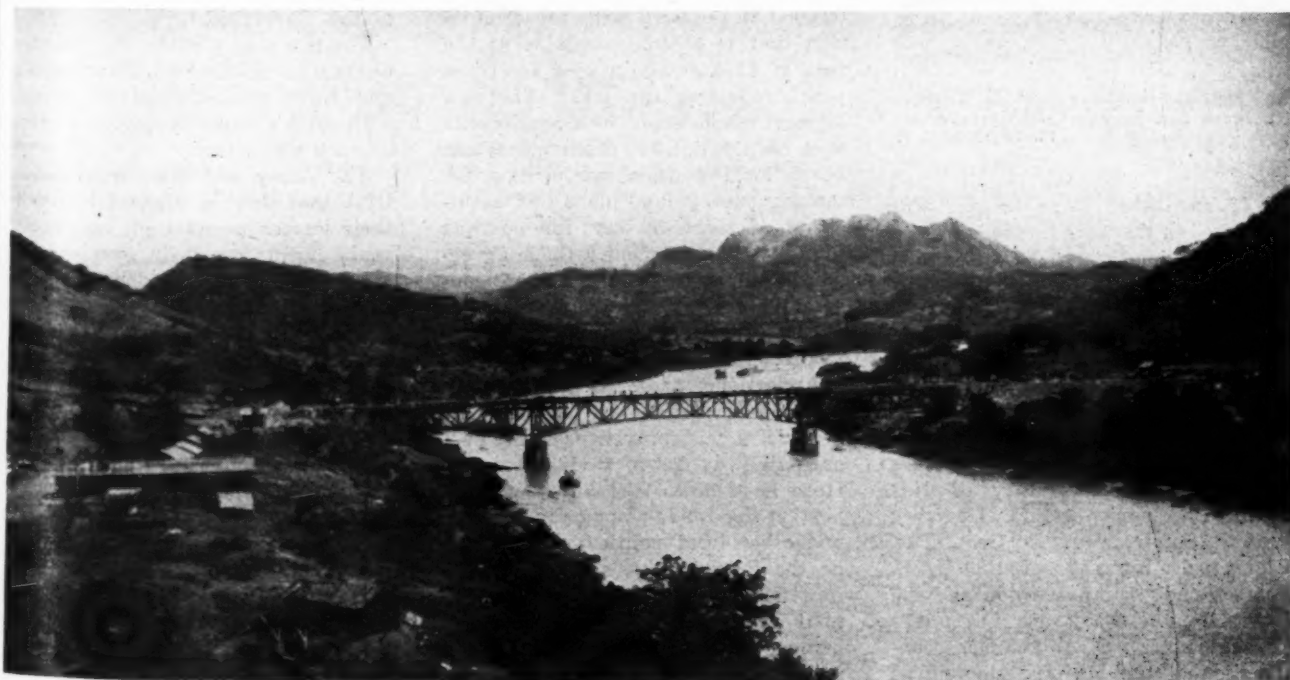
### Bridges

El Salvador is a land of many streams and hence of many bridges. Most important among them are the Cuscatlan bridge over the Lempa River at Paso de San Lorenzo and the International bridge over the Goascoran which is owned jointly by the republics of El Salvador and Honduras. The former is a suspension



At left: Engineer Don Juan P. Camino, Director General de Carreteras of the republic of El Salvador. At right: Engineer, William A. Reeve, Senior engineer, bridge department, John A. Roeblings' Sons Co., Engineer and superintendent of construction, Colima bridge over Rio Lempa

structure 1,350 ft. long with a main span of 820 ft. It was completed in 1942. The Goascoran River bridge is a 480-ft. 3-span cantilever finished in October, 1943. Third in importance is the Colima bridge now under construction to carry the North Road over the Lempa. John A. Roebling's Sons Co., of Trenton, New Jersey, U.S.A., is the contractor. It is doubt-



International bridge over Goascoran river between El Salvador and Honduras, nearing completion Oct. 1943

Photo by J. C. B.



Applying penetration asphalt on Pan American highway 40 miles east of San Salvador

Photo by courtesy of Dirección General de Carreteras



Pan American Highway near Coatepeque between San Salvador and Santa Ana  
Photo by J. C. B.

ful if any other large bridges will be erected in the near future, as there is no indication that traffic will justify their cost. Ferries, after all, are a very practical expedient. Smaller structures, however, will be needed at many points.

#### Administrative Officials

Heading the Dirección General de Caminos are Engineer Colonel Carlos Mejia Osorio, Subsecretary of National Development, and Engineer Juan P. Camino, Director General of Highways. Interests of the U. S. Public Roads Administration and the Export-Import Bank are in charge of Engineer W. C. A. Palmer. Construction of the Military Route was directed by Col. Edwin C. Kelton, Director, Pan American Hwy, Lt.

Col. W. W. Zass, Area Engineer, and Capt. George H. Barton, Resident Engineer, all of the Corps of Engineers of the United States Army.

#### Bill for Billion Dollar County Road Program

Under a bill (S. 1498) introduced by Senator Stewart of Tennessee, a new federal agency, the Rural Local Roads Administration, would be established to administer federal-aid funds for country and other local road construction.

An initial authorization of \$1,125,000,000 is provided with the stipulation that it become available at the rate of \$375,000,000 a year for three years following the war. The new agency would enter into agreements with county highway departments and other local political authorities for making surveys and plans and acquisition of rights-of-way for postwar highway improvement. Such agreements would constitute federal contractual obligations for payment of pro rata share when funds are made available.

Apportionment in the first instance would be made among the states in accordance with provisions of the Federal Highway Act of 1921. From the state level down, the bill would apportion the funds among the counties and other local political subdivisions on the following basis: 50% in ratio that mileage of roads used for rural mail delivery, star routes, or school bus service in each county or other subdivision bears to the total mileage of such roads in the state; 30% in ratio which population of each county

or other subdivision bears to total state population; and 20% in ratio which area of each county bears to area of state. Federal share to be 75%. The government may advance the federal share to expedite completion. Funds for county road construction would remain available for matching for a period of three years, then, if not matched, reapportioned among other counties. Sums allocated to towns or townships would remain available for matching for two years.

Counties to meet certain minimum standards as to competency. Where counties are unable to meet standards on qualifications they may join with other counties to maintain a qualified highway department. Counties unable to meet the federal requirements may negotiate with the highway department of the state in which they are located to perform on their behalf.

#### New OPA Leasing Arrangement

A new pricing arrangement for leasing construction and road maintenance equipment to contractors by the War and Navy Departments and other Government agencies became effective Nov. 30. The action will simplify Government inspection of repairs.

Under previous regulations, the lessor had to bear expense of all repairs to leased equipment necessitated by normal wear and tear, and the Army and Navy were required to inspect every repair made by lessees to determine the cause of breakdown and what proportion of the cost chargeable to the Government.

The new step provides for a simpler alternative method so that the War and Navy Departments can comply with OPA's controls covering rental of such equipment.

The Army and Navy proposed to OPA that they be allowed to require their lessees to make all repairs and replacements at their own expense, conditional upon a reduction in the rental rates charged by the Army and Navy.

Accordingly, OPA approved this arrangement on the condition that the maximum rates to the lessee will not exceed 85% of the maximum rates in the Regulation. The 15% reduction will properly reimburse lessees for the portion of costs and repairs that would have been borne by the lessor, OPA said.

However, the action does not shift to the contractor the burden of repairing pre-existing or hidden defects that may become manifest and cause breakdowns while the equipment is in his hands.



# Federal-Aid and Its Relationship with the States

## Purpose and Procedure

The Federal-aid system and program of highway development were inaugurated in 1916.

The first law served a specific and laudable purpose, as it insisted upon the establishment of state highway departments and systems in states of lesser financial ability as requirement for assistance, and thus developed a co-ordinated system of inter-state and intra-state highways to meet motor transportation demands. Without this law proper development of an adequate highway transportation system would have been delayed many years, and in a few states might never have been developed.

The intent of the original law was and is to aid the individual states financially; to designate an agency (now Public Roads Administration) to act in a consulting and advisory capacity to state authorities; to establish and co-ordinate standards of design, specifications, types and methods of construction as they would apply to meet varied needs of individual states; and to supervise in general state activities to assure the Federal Government an adequate return.

Under the original act, Federal-aid was limited to 50% of the cost, or not more than \$10,000 a mile. This limitation was subsequently increased to \$20,000 per mile, later decreased to \$16,250, and until 1932 to \$15,000 per mile. Now Federal funds can participate to 50% of the total cost of the project. The Defense Highway Act of 1941 permits 75% Federal participation on the Strategic Network.

## Basis of Allocation

Federal-aid funds are allocated to the various states and territories, based on  $\frac{1}{2}$  each of the ratio in which the total area, population and mileage of each state bears to the total area, population and mileage of all the states and territories.

Each state is required, under PRA rules, to submit a detailed program of proposed projects for the utilization of any apportionment of funds to that state under the Federal Act. The program must be in tabular form, give detailed information and must be accompanied by Federal-aid maps showing each project location. After approval we are in a position to proceed with a submission to them of de-

By JOHN U. SHROYER

Secretary of Highways,  
Pennsylvania Department of Highways, Harrisburg

*How should post-war Federal aid be allocated and administered? Herein ROADS AND STREETS is privileged to present an important and timely discussion. Mr. Shroyer speaks both as a rugged individualist and as the representative of a state long proud of its record for standing on its own financial feet. Perhaps you do not agree with all parts of this analysis.*

tailed plans, requesting their approval to advertise an individual project.

After Federal engineers have checked and authorized plans and estimates construction, bids are received and the Government must concur in the award to the lowest responsible bidder before contract may be executed and work proceed.

During construction the work is subject to inspection by Federal engineers and they must concur in final acceptance.

Great credit is due to the pioneers in this movement and their successors, who, on the whole, have produced a record of real accomplishment.

## Appropriations and Financing

The first F.-A. appropriation totaled \$5,000,000 for the U. S. for 1917. Pennsylvania's share was \$230,644, or 4.61% of total.

From 1917 through 1943 Federal-aid and emergency highway appropriations totaled \$3,745,000,000; Pennsylvania's share was \$170,862,971.00, or 4.56% (not including W.P.A. or similar executive relief allocations).

The original allocation of funds on the basis of  $\frac{1}{2}$  each of area, population and mileage of post roads has never been changed although there have been enormous changes in our transportation requirements in the past quarter century due to agricultural and industrial development.

## Present Formula Outmoded

Pennsylvania, being one of the large industrial states, feels that the present formula has been outmoded in that it does not provide sufficient consideration for distribution of population, motor car and truck transportation, industrial employment and source of revenue, all of which are

predominant factors in actual highway needs.

Over a dozen proposed formulae have been offered by leaders for consideration of the Congress for amendment of the present allocation system. Two have been most widely discussed. The one was prepared by the Executive Committee of the American Association of State Highway Officials. It would allocate Federal funds on the basis of  $\frac{1}{2}$  population,  $\frac{1}{4}$  area and  $\frac{1}{4}$  post roads. The other, by William J. Cox, State Highway Commissioner of Connecticut, would allocate on the basis of  $\frac{1}{2}$  population,  $\frac{1}{4}$  motor-fuel consumption,  $\frac{1}{4}$  post road mileage.

The Pennsylvania Department of Highways prepared a formula premised on  $\frac{1}{2}$  on the basis of the present Federal-aid formula and  $\frac{1}{2}$  on population (Shroyer formula).

Of ten formulae analyzed by the Pennsylvania Department, Pennsylvania's share would vary from 4.19% (present formula) to 6.22% (Cox formula). The Executive Committee formula would allocate us 4.97%; the Shroyer formula, 5.79%.

While each suggested formula would benefit Pennsylvania above the existing legislation, the one proposed by the A.A.S.H.O. and incorporated in H. R. Bill 2426 now before Congress would be the least advantageous.

## Constructive Thinking Needed

While there has been much talk on post-war planning and construction, there has been a minimum of constructive thinking on the means and methods of financing.

State roads have been financed principally from net proceeds of motor license fees and gasoline tax. Tax rates vary, but this basic principal of financing state highway activities and aiding local communities in their highway and street problems is universally accepted throughout the U. S.

Over \$215,000,000, or 14.8%, of \$1,450,000,000 total state funds was used for non-highway purposes in 1941. This and similar diversions has led to legislation and constitutional changes in many states to prevent future use of motorists' taxes for any purpose other than the construction and maintenance of highways. In Pennsylvania, 1 cent of gas tax is



expressly levied for relief; \$16,300,000 in 1941 or 15.3% of total motor revenues.

It is interesting to study the Federal record of taxation on motorists. According to A.A.S.H.O. records more than \$3,000,000,000 excise taxes were collected from this source in the 9 years to June 30, 1941; to June 30, 1943, an additional \$1,200,000,000, or \$4,200,000,000 in 11 years. This compared with \$3,745,000,000 of total Federal aid and emergency appropriations since 1917. In the 11 years to 1941 Federal-aid and emergency funds were \$2,500,000,000. Therefore, there has been a diversion of Federal motorists' taxes in this period of \$1,700,000,000, or more than 40%.

### 80% Federal Diversion

Federal diversion for year ending June 30, 1942, was about 80%. The largest state diversion for non-highway purposes in 1941 was in New York, \$64,000,000, or over 52% of total state motor and gas taxation.

It is recognized that we are at war. These figures are not presented in a spirit of criticism but as facts which must be considered in developing and financing any post-war program of highway improvement.

Federal excise taxes paid by each state for the fiscal year ending June 30, 1942, on the basis of actual use of vehicles and gasoline consumption, vary from \$1,083,000 in Nevada (0.16% of total) to \$56,671,000 in California (8.37%). In Pennsylvania it amounts to \$45,364,000 or 6.70%.

Comparison of Federal motor excise taxes paid to Federal-aid received under the existing formula discloses that 16 states, with 55% of the population, pay 60% of the taxes. They would receive only 37% of the allocation. Each of these states would receive a less percentage than they pay in taxes: California, Connecticut, D. of C., Florida, Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Washington and Wisconsin.

By the Executive Committee Formula, these same 16 states would receive 41.5% of the Federal allocation.

By the Cox Formula, Colorado, Oregon and Texas would join the group paying in more than they would receive. This makes nineteen states representing 62% of the population. They are paying 68% of the excise taxes, would receive 57.6% of the allocation. This is a much fairer percentage to those states which have the population and produce the taxable wealth which renders the Fed-

eral-aid system possible. These states represent 77.9% of the nation's industrial employment.

We have not analyzed latest figures on the actual need for additional highway construction and modernization to meet traffic demands. When these are developed it will be proved definitely that the expanded wartime commercial and military traffic has created the most damage to highways in the industrial states, and that the actual requirements in most of these states will be in excess of any appropriations available.

### F. A. no Longer Needed as Subsidy

Careful analysis leads to the simple and sound deduction that Federal-aid should no longer be considered as an appropriation or a subsidy. Most states have demonstrated that the state highway systems are a self supporting industry, exchanging their services for state-collected motor license fees and gasoline taxes in the same manner as public utility companies exchange service for fixed tariff charges. The only states which have failed to establish this principle are a few with sparse population, too large diversions to local communities for highway purposes, or straight diversions for non-highway purposes. This reasoning may also be applied to states having bonded indebtedness too high for economic safety.

In the early days F. A. funds were appropriated from general taxation. Since 1933, taxes from motorists have been 1.7 billions above Federal-aid and Emergency Road Appropriations. With the decline in Federal motor excise taxes in 1942-43, receipts for this fiscal year dropped to 522 millions. It may be assumed that the total during this war period will not go much below 500 millions per year, with an accelerated increase immediately after the war.

It is therefore suggested that the states appear before Congress not with the attitude of seeking subsidies or appropriations but with the time-tried and proved business theory that money collected from the motorists should be returned to them for improving their highway systems.

With more than a 1½ billion diversion credit due motorists since 1933, and with a minimum current tax collection of ½ billion per year, it is only common-sense reasoning to expect that Congress should and will return 1 billion of dollars per year for a 3-year post-war state construction program. Any other course would be taking advantage of motorists by placing an unfair tax upon a special class. The only other fair alternative would be

for the Federal Government to retire from motor excise taxation, leaving the field clear to each state for taxing motorists as necessary to solve its own problem. This may entail hardships upon a few less prosperous, scantily populated states.

It has been argued that large sums were appropriated for W.P.A. and similar agencies and that a large percentage was expended on highways. Such appropriations were for general relief, and a special class of people called motorists should not be taxed specifically for conditions applying primarily to the general welfare.

Also contended is that appropriations have been made for military and war-industry access roads. These are as direct a charge against specific war activity. Motorists as a class should not be expected to assume this burden.

### Prove Road Building Self-Supporting

This theory of the State Highway Industry as a self-supporting and going business concern should be further developed with all the available facts, and presented to Congress in such a manner that no reasonable or valid argument can be presented against it.

It must also be clearly demonstrated by further specific data that, under our government of majority rule, more consideration must be given to increased Federal allocations to the states which have the greatest population, largest industrial employment, and largest car and truck registration, all of which entail greater use of highways with attendant necessity for increased facilities in the form of new construction, reconstruction, resurfacing and modernization of the highway system. The Cox Formula approaches this condition in a more sensible and realistic manner than the proposal contained in H. R. Bill 2426, and should be given proper consideration by the Congress.

### Rights and Responsibilities of Sovereign States

People view with alarm the growth of bureaucracy and its increasing domination over sovereign state rights. Honorable Hatton W. Summers, in September, 1943, "Reader's Digest" ("Don't Blame the Bureaucrats"), has intensified the thinking of the common citizen as to dangers created.

Sovereign states can conduct their governmental functions, under their own duly qualified, elected officials, with minimum assistance and interference by Federal Bureaus. Thinking

people subscribe whole-heartedly to Congressman Summers' philosophy that it is beyond human intelligence to operate this great country from a central source in Washington.

The growth of bureaucracy in administration of the Federal-aid Law has kept pace with increase of Federal control over all activities of the states and their citizens. Again, Congress is not to blame. Neither are the Federal Administrators. The failure lies in the apparent willingness of responsible state authorities to trade their sovereign rights for appropriations or subsidies in other forms, and in not insisting upon their privilege to carry on their functions under their own control.

In examining past Federal-aid practices, one fact is most outstanding. Total F. A. payment in any one year has been small compared with state funds collected or expended for highway purposes. Example: Total 1940 state highway receipts were \$1,625,000,000. Total F. A. payments were \$170,704,000, including extra payments to certain states, or only 14.4% of the total. These Federal funds were considerably less than the 215 millions expended by states that year from their own funds for state highway maintenance. Total state highway construction costs, to which F. A. funds were applied, are \$523,000,000.

### Why Bureaucratic Growth?

It appears reasonable to deduce that if the properly elected and appointed state highway officials are capable of expending large sums paid by their own citizens for highways, they are equally capable of expending the Federal funds, which are provided by the same citizens, without the steadily increasing bureaucratic control and expense.

State highway administrators and engineers have developed into competent executives and technicians over the hard road of practical experience in solving the problems in their individual states. Federal administrators and engineers who, in many cases, have had less experience in the individual states, are not superior to the "home-grown and experienced brand" regardless of their educational qualifications or honest intent. Bureaucratic control of state highway problems is leading toward monumental designs and construction which cannot be justified on the basis of past experience, present and future traffic and the service record of highways constructed in and by the states.

Is it not reasonable to assume that the states . . . can develop men and women capable of directing the state

government with which they are most familiar?

### Challenge to State

Each state should take a complete inventory of its own possibilities and responsibilities. It may be possible that changes and modifications can be made in its own taxing and operating structure which will permit it to assume a fuller responsibility toward its citizens with a minimum of Federal assistance. It must be remembered that "Control follows the dollar." Increased subsidies from the Federal Government result in increased control by Federal bureaus.

A recent example of Federal legislation detrimental to state responsibility was Public Law No. 146 (78th Congress), approved July 13, 1943. It provided that a certain portion of the states' unobligated Federal-aid balances could be used for surveys, plans, specifications, engineering and economic investigations, etc. This Act did not provide new funds. It merely permitted existing funds, earmarked originally for construction, to be used for surveys and plans, thereby reducing funds available for future improvements. How can any state ever hope to approach economic highway independence if it has not sufficient state funds available for surveys, plans, etc., which represent such a small portion of actual construction costs? How can any state avoid complete domination of its entire state highway department by a Federal bureau if it depends to such an extent upon Federal funds for its normal minor operations?

Due to the large volume of highway construction necessary to rehabilitate the state highway systems, on account of fatigue, obsolescence, damage to structure by war traffic and war delay in reconstruction, a greater degree of common sense must enter into the planning and designing of individual projects. Provision must be made for present traffic and future expansion, but the trend to design and construct monumental projects must be subordinated to the practical, useful and more economical.

Now is the time for state highway development to be returned to the original intent of Federal-aid legislation. It should be the function of the designated Federal agency to coordinate the activities of the several states and to meet commonly accepted standards of engineering performance. A minimum of supervision and control should be exercised.

There is a definite Federal responsibility to develop and correlate the

Strategic Network and Inter-regional System. This can also be accomplished through the recognized and capable state highway departments without additional personnel or Federal control. These highways are within state borders and should remain under state control. Duplications are unnecessary and expensive.

### Pennsylvania's Position on Highway Development

Pennsylvania assumes the position that, while organizations and committees are capable of presenting a general picture of a problem which may affect the states as a whole, the state's duly elected or appointed officials are the only ones qualified and responsible to present the facts pertaining to its specific problems. When Pennsylvania officials present their case they represent 10 million citizens of whom 2¼ millions are motor vehicle owners (7.4% of nation's population, 9.28% of the industrial employment).

Pennsylvania is responsible for the construction, reconstruction, maintenance and operation of 40,500 miles, including 17,000 bridges. Some 62.4% of state traffic is carried on this state highway system; eliminating urban compacts, 91.4%.

More than 34,000 miles have an improved surface. This is the largest state system in the U. S. and the largest improved mileage. More than 25,000 miles have a bituminous surface subject to periodic surface treatment with bituminous materials and mineral aggregate, thus intensifying the maintenance problem to a degree not experienced elsewhere.

### Billion State Investment

The investment in Pennsylvania state highways is more than 1 billion dollars. The State of Pennsylvania is capable, financially and otherwise, of maintaining this vast network, even under wartime traffic and regulations, without Federal assistance.

Prior to the war, the Federal-State records disclosed that, on the basis of road life studies, necessary reconstruction of the state system would cost almost 1 billion of dollars in the 20 years to 1962.

The war has decreased passenger car traffic but truck traffic has increased in weight and volume. Military maneuvers and convoys have intensified the problem. More damage to highways from traffic, especially on main trunk lines, is occurring than in normal years. Pennsylvania, as a war emergency measure, increased the permitted axle loading of commercial





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Maintenance costs will be about  $\frac{1}{2}$  greater during the current year than prior to the war. Shortages and restrictions have necessitated postponement of urgent overdue resurfacing and reconstruction. Despite all of these handicaps, continuous and adequate all-year service has been provided for war and civilian traffic. Minimum improvements and replacements will require 500 million dollars.

### Pennsylvania Finances

Pennsylvania finances state highway improvements from motor license fees, gasoline taxes and Federal-aid, minor local contributions. Of the 4c state gas tax (U. S. average),  $2\frac{1}{2}$ c reverts to the highway department,  $\frac{1}{2}$ c to the counties for local road and bridge improvement, and 1c emergency tax for relief, etc. From the  $2\frac{1}{2}$ c more than 1c is utilized for state departments engaged in collecting fees, issuing the tags, policing the highways, interest, and sinking fund on existing state highway bonds, and further aid to local communities by direct highway appropriation to second-class townships.

Assuming that motor revenues will return to the 1941 level (normal year), total state funds available for state highway purposes after deductions and not including Federal-aid, would amount to 68 millions yearly. Of this, 32 millions are required for administration, maintenance and operation of state highways. With no changes there would be available 36 millions per year to perform a job costing 100 millions per year for a 5-year period. If economic conditions remain as they are, without further Federal restrictions, Pennsylvania should have about 35 millions of surplus saved during this war period. This would enable Pennsylvania to produce almost one-half her post-war state highway improvement obligations for a three-year period. Therefore, on a proposed 75-25 Federal-aid formula, Pennsylvania is able to finance her share of a 1 billion dollar national Federal aid program for a 3-year period as at present contemplated.

Pennsylvania practices "home rule" in dealing with governmental subdivisions. On the  $\frac{1}{2}$ c gas tax annually appropriated to counties, which normally exceeds 8 millions per year, there is no direct supervision, the only stipulation being that it shall be used for highway and bridge purposes including amortization of highway bonds. Of the 4 millions appropriated

### STATE AND FEDERAL EXPENDITURES BY AND FOR PENNSYLVANIA DEPARTMENT OF HIGHWAYS

Year	Total Net State Expenditures	Motor Fund Expenditures (Excluding F. A.)	General Fund Expenditures	Total State Expenditures	Trust Account	Federal Aid	P. W. A. (Buildings)	Relief Thru General Fund of State	Special on Railroads	(Fed. Agency) W. P. A. or Predecessor	Total Exp. on State Hwy.	Total State and Federal	Percentage State	Percentage Federal
1929-30	\$55,345,107.79	\$12,000.00	\$12,000.00	\$55,357,107.79	\$3,749,222.09	\$3,749,222.09					\$3,749,222.09	\$9,106,328.88	93.7	6.3
1930-31	75,631,381.38	12,000.00	12,000.00	75,643,381.38	6,176,711.53	6,176,711.53					6,176,711.53	79,820,102.91	92.3	7.7
1931-32	47,068,982.39	12,000.00	12,000.00	47,080,982.39	9,481,226.97	9,481,226.97					9,481,226.97	56,540,189.36	83.3	16.7
1932-33	46,507,860.53	12,000.00	12,000.00	46,519,860.53	6,671,410.37	6,671,410.37					6,671,410.37	53,191,270.16	82.6	17.4
1933-34	50,977,362.58	12,000.00	12,000.00	50,989,362.58	5,211,512.86	5,211,512.86					5,211,512.86	56,061,887.62	76.8	23.2
1934-35	59,712,023.49	12,000.00	12,000.00	59,724,023.49	15,894,877.93	15,894,877.93					15,894,877.93	75,618,960.56	78.9	21.1
1935-36	59,367,063.19	12,000.00	12,000.00	59,379,063.19	15,894,877.93	15,894,877.93					15,894,877.93	75,618,960.56	78.9	21.1
1936-37	65,329,767.70	12,000.00	12,000.00	65,341,767.70	4,538,235.43	4,538,235.43					4,538,235.43	101,451,619.56	34.0	66.0
1937-38	61,135,850.66	12,000.00	12,000.00	61,147,850.66	8,311,927.01	8,311,927.01					8,311,927.01	122,824,704.54	45.0	55.0
1938-39	61,135,850.66	12,000.00	12,000.00	61,147,850.66	8,311,927.01	8,311,927.01					8,311,927.01	122,824,704.54	45.0	55.0
1939-40	49,688,890.99	12,000.00	12,000.00	49,700,890.99	2,941,926.42	2,941,926.42					2,941,926.42	145,909,068.60	42.4	57.6
1940-41	58,432,188.40	12,000.00	12,000.00	58,444,188.40	6,268,983.47	6,268,983.47					6,268,983.47	149,688,052.07	41.9	58.1
1941-42	59,438,999.12	12,000.00	12,000.00	59,450,999.12	6,557,760.92	6,557,760.92					6,557,760.92	156,245,813.00	42.0	58.0
1942-43	51,373,058.82	12,000.00	12,000.00	51,385,058.82	21,812.97	21,812.97					21,812.97	60,464,851.82	85.0	15.0
Total	\$768,736,638.49	\$160,944.37	\$160,944.37	\$768,897,582.86	\$52,225,181.63	\$52,225,181.63	\$2,154,764.08	\$7,681,649.77	\$253,383.71	\$333,497,048.00	\$471,378,920.33	\$1,240,276,503.19	62.0	38.0

annually to second-class townships, the local authorities expend the money under their direct supervision and control. A periodic statement is furnished to the state, and only general supervision exercised. We have demonstrated in Pennsylvania that such home rule can be operated with no waste of public funds to the satisfaction of the citizens.

The situation in Pennsylvania is duplicated to a greater or less degree in the other states.

### Not Dependent

Pennsylvania has not been dependent upon Federal-aid for past state programs. *Example: during the four years to May 31, 1943, construction, reconstruction, resurfacing and widening totaled \$143,653,000, of which \$28,669,000 was Federal-aid, or 20%.* The Federal funds were highly appreciated but represented a small percentage of the motor excise taxes paid by Pennsylvania motorists into the Federal Treasury.

Pennsylvania does not desire a return of W.P.A. or a similar Federal agency in post-war work. From June 1, 1935, to May 31, 1939, Federal W.P.A. or preceding similar agency's expenditures on Pennsylvania state system was \$269,557,760. Federal Government paid 93.6% of the total cost. For the four years to May 31, 1943, Federal W.P.A. expenditures were \$63,936,288; Federal share, 75%.

### WPA Waste

The total W.P.A. expenditures of almost 333½ millions was a far greater sum than would have been necessary to rehabilitate the entire state highway system if expended by the states under the Federal-aid or similar system. As a further commentary on the inefficiency of W.P.A. in highway development, more total physical work was performed in the 1939-43 period when approximately 64 millions of Federal funds were expended than from 1935 to 1939 when almost 270 millions of Federal funds were expended.

It may be purely coincidental that the largest WPA outlay of 91¼ millions was expended in an important State election year, 1938.

It may be contended that W.P.A. expenditures were for relief of unemployment with physical accomplishments being considered as of secondary importance. On this premise it is more important to provide funds for State Highway development to prevent a recurrence of industrial de-

pression than to waste funds in an attempt to cure the condition after it has developed.

The table (see preceding page) substantiates the above and proves definitely that Pennsylvania has lived up to her sovereign obligations in highway development. It further proves that large expenditures of Federal money under direct Federal supervision do not replace the common-sense efficiency of State organizations. The high total and percentage of Federal expenditures from 1935 to 1939 are not reflected in increased accomplishments. This is a most specific argument against further Federal bureaucratic control.

### Summary

The Pennsylvania Department of Highways contends that:

1. A post-war depression can be avoided by a partnership between industry and Government to provide employment, with industry, as the senior partner, assuming the larger responsibility.

2. Public works construction under the competitive contract system can aid in providing for excess employment above requirements of industry.

3. State highway construction can play the principal role in a Public Works Program of increasing assets and providing employment.

4. It is a greater obligation to rehabilitate the war traffic-damaged state highways of this Nation than it is to reconstruct similarly war-damaged areas in other countries.

5. It is unfair to tax motorists as a class for general welfare purposes, except during emergencies when such taxes should be considered as a credit for later consideration and return to the motorists for highway purposes.

6. Motorists of the Nation have been and are willing to pay for the cost of providing the roadway for the motor transportation system if their taxes are returned in highway improvement.

7. There has been excessive diversion of motor excise taxes by the Federal Government. By the return of this diversion and continuation of existing taxation during the post-war period 1 billion dollars per year can be provided for a 3-year highway program.

8. State highway construction can be handled by the state highway organizations under minimum Federal supervision, more speedily, efficiently and economically than by the establishment of new or enlargement of existing Federal agencies.

9. All state highway and a proper proportion of local highway needs can be financed from motor taxation without any additions to general Federal or state taxation.

10. It is more important to the welfare of the Nation for the individual states to maintain their sovereign rights and live up to their responsibilities than it is to forego and relinquish them for Federal appropriations or subsidies.

11. In allocating motor excise funds, the larger wealth-producing states must be given greater consideration in Federal legislation compatible with the requirements of such states.

12. From a highway standpoint, population, area, traffic, industrial employment and highway needs must be given greater consideration in such allocations.

13. Large direct expenditures for highway purposes by Federal agencies under the guise of relief have been uneconomical, wasteful and encourage political and bureaucratic intimidation.

14. "Home rule" as practiced in Pennsylvania without bureaucratic controls can be placed in effect throughout the Nation with increased efficiency and reduced costs.

15. Pennsylvania contends after a thorough study and analysis of the several formulae advanced for Federal allocation of funds that the one prepared by Honorable William J. Cox of the Connecticut State Highway Department meets the highway needs of the Nation and the individual states more adequately than any that have been considered. Pennsylvania therefore endorses and recommends this formula for the favorable consideration of the Congress. However, Pennsylvania does not endorse any proposals or allocations for specific express highways as each inter-regional highway should stand or fall on its own merits after due analysis by competent Federal and state engineers.

### W. Virginia Cuts Bond Interest Load

West Virginia's bonded indebtedness, made up almost entirely of good roads issues voted in the '20s, has improved to such an extent in the last 10 years that interest charges are now more than \$1,000,000 lower, State Treasurer R. E. Talbott reported recently. Liabilities which totaled \$92,529,400 on June 30, 1934, were down to \$71,053,000 at the end of the last fiscal year.



## Cost Finding on Street Repairs

## How Cincinnati compiles, reports and uses cost data for use at hearings and in checking job efficiency

**E**FFICIENT operation of a street maintenance organization is indicated by the quality, quantity and cost of the work done. Any competent supervisor can know by visual inspection incident to the work whether the work being done is of satisfactory quality and adequate in quantity; but, unless he has current unit costs of the various operations, he has no way of knowing whether he can complete his work program within the money allotted nor can he know the relative efficiency of the various crews under his supervision.

The writer's service with Cincinnati has extended over a period of 32 years, and it seems to him that Cincinnati has always been cost conscious, as he has been and is perennially faced with the question "What will it cost?"—at budget hearings, appropriation ordinance hearings and throughout the year when any improvement or service project is proposed; and thereafter the question changes to "what did it cost?"

To meet this situation a somewhat crude and inadequate system of cost finding was installed in the Street and Sewer Repair Department (now known as the Division of Highway Maintenance) in 1912, which was elaborated and greatly improved in 1926, and mechanized by the use of tabulating equipment (punch card system) in 1931.

### What Our Costs Include

The unit costs contain only direct cost items which include actual labor costs, material costs plus a 10% handling charge, and equipment costs. This last item is developed in the form of "rental rates" from the cost records of the Municipal Garage. All maintenance costs are consolidated monthly for each piece of equipment. The vehicles and specialized construction equipment items of the Highway Maintenance Division are then divided and consolidated into groups of similar items (all 3 to 3½ ton trucks, all gas shovels of similar rated capacity, all compressors of similar rated capacity, etc.), certain overhead charges such as depreciation are added and these results divided by a weighted estimate of probable hours of operation. The resultant sum is then used as the "rental rate" per hour in any operation in which any item is used. In this manner the cost of an hour's operation of a particular

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Supt. of Public Works Records,  
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unit will always be uniform and therefore, its production can be compared.

Cincinnati operates two asphalt plants, both of which are located on the same site. These plants mix a number of products, including both hot and cold asphaltic concrete, binder sheet asphalt, etc. In order that these material items can be correctly charged into the street work, very careful costs are reported to this office daily where they are priced, extended and punched on tabulating cards. At the end of a month, a report is run showing direct costs of manufacture. At the end of the year, these monthly reports are consolidated, weighted by any change in labor costs and costs of component materials, certain overhead and burden charges added. The resultant unit costs are used to price these various mixes in the current-year maintenance costs.

### How Costs Are Turned in

Briefly, all basic operations of the division are listed and given a code number. Crew foremen fill out daily production reports (sample copy herewith) which are segregated into jobs and operations, sent to the Division of Records (one of the six subdivi-

sions of the Public Works Department) where cost items are priced and extended, operations coded, tabulation cards punched and, at regular and predetermined intervals, sorted and listed in the form of reports, copies submitted to the Superintendent of Highway Maintenance Division and summarized reports submitted to the Director.

As soon as these reports are in the hands of the Maintenance Division the analysis begins. Comparisons are made, operation by operation, with the reports of the preceding interval and with the corresponding interval of the preceding year or years, so that any substantial variation, up or down, in unit costs is immediately apparent and in case of such variations the entire situation is analyzed in order to determine the cause so that suitable corrective action can be taken if the situation warrants such action.

The Highway Maintenance Division operates, to a very large extent, through "Job Orders" issued to the field from the general office. Most of these job orders cover routine maintenance instructions and no job costs are necessary; however, there are a large number issued to authorize extensive projects, of a new construction or "betterment" nature, on which costs are desired. These job costs are ac-

[illegible]

Fig. 1. Foreman's daily report sheets, the first step in Cincinnati's cost keeping, are designed to facilitate ready classification of data. Other side of this form (not shown) provides space for listing quantities and materials and items of equipment used

**HIGHWAY MAINTENANCE DIVISION**  
**FIVE YEAR DIRECT UNIT COST COMPARISONS**

No.	Section	QUANTITIES					Average Annual Quantity	UNIT COSTS			Average Unit Cost		
		1942	1941	1940	1939	1938		1942	1941	1940		1939	1938
2000 ASPHALT SECTION (Manual)													
2001	Asphalt with Asphalt	79,981 sy	76,354 sy	91,343 sy	67,420 sy	96,735 sy	72,367 sy	.57	.57	.57	.67	.65	.606
2002	Boulder with Asphalt	3,800	250	5,508	18,180	17,775	9,103	.50	.69	.55	.55	.49	.523
2003	Brick with Asphalt	10,460	326	25,469	29,279	21,546	17,416	.49	2.06	.40	.42	.51	.449
2004	Concrete with Asphalt	4,764	1,576	1,302	21,179	312	5,627	.47	.96	.52	.37	.73	.407
2005	Woodblock with Asphalt	395	11,916	8,520	8,699	7,948	7,506	.48	.39	.39	.45	.49	.425
2006	Granite with Asphalt	10,139	20,425	4,599	25,388	23,112	16,732	.55	.50	.52	.41	.58	.502
2007	Macadam with Asphalt	22,150	44	38	66	4,545	5,369	.33	1.11	1.27	1.48	.46	.347
2008	Base Work Only	10,706	15,242	8,392	8,507	7,041	9,978	1.12	1.08	1.04	1.09	1.16	1.095
2009	Misc. Asphalt Work							\$7.629T	5.296T	12.371T	11.037T	4.373T	
2011	Hot Mix on Asph. (Mech.)		10,374	24,162			17,268		.37	.33			.338
2012	Hot Mix on Boulder		13,515	3,391			8,453		.44	.42			.438
2013	Hot Mix on Brick		27,647	89,646			58,647		.35	.28			.295
2014	Hot Mix on Conc.			16,403			16,403			.33			.326
2016	Hot Mix on Granite	46,889	24,538				35,714	.40	.34				.380
2017	Hot Mix on Macadam		18,703	507			9,605		.34	.45			.334
2022	Cold Mix on Boulders		19,564	5,758			12,661		.31	.35			.320
2023	Cold Mix on Brick (Mech)		1,011				1,011		.32	.22			.318
2024	Cold Mix on Conc.		4,112				4,112		.21				.211
2027	Cold Mix on Macadam		50,275				50,275		.27				.268
2000 CONCRETE SECTION													
2101	Concrete Surface	1,984 sy	463 sy	672 sy	1,480 sy	2,318 sy	1,383 sy	2.86	5.50	4.88	3.17	4.94	3.870
2102	Concrete Base	971	785	871	1,283	3,485	1,479	3.37	3.77	3.88	3.26	3.55	3.456
2103	Crackfilling	12,962	23,845	13,170	14,067	5,534	13,912	.23	.20	.25	.19	.32	.224
2104	Joint Cutting	hds. l.f.	hds. l.f.	hds. l.f.	hds. l.f.	hds. l.f.	hds. l.f.						
		1,216	464	434	1,420	1,054	914	.79	.83	1.22	.74	.69	.794
2105	Concrete Surfacing	44 sy	1,669 sy	19 sy	24 sy	222 sy	396 sy	2.59	.32	.87	2.11	.76	.450
2109	Weldjack Operation	25,604	34,702	33,540	37,934	31,331	32,622	.34	.41	.45	.44	.53	.438
2110	Reset Castings	189 ea	367 ea	205 ea	189 ea	120 ea	214 ea	10.80	10.20	10.20	7.63	7.92	9.579
2112	Concrete Curb & Gutter	5,097 lf	8,900 lf	7,950 lf	6,282 lf	13,903 lf	8,426 lf	1.14	1.09	1.06	1.14	WPA.34	.852
2113	Drill Test Holes							351 T	389T	243T	216T	264T	
2114	Break or Cut Out (Misc.)							779T	314T	172T	1670T	2803T	
2000 PATROL & MISC. SECTION													
2203	Hauling (Misc.)							7.785T	8.124T	9.391T	14.172T	32.570T	
2205	Roughening Street Surface			1,210 sy			1,210 sy						.112
2206	Sand, Cinder, Salt - Jay Streets							42.416T	14.685T	26.855T	19.966T	14.970T	
2207	Sand or Chip - Bleeding Streets							110T	297T	16T	7T	1,119T	
2211	Rolling (Misc.)							52T	467T	881T	741T	4,600T	
2215	Sodding	4,449 sf	22,215 sf	20,634 sf	20,736 sf	59,536 sf	25,714 sf	.05	.03	.04	.03	WPA.03	.033
2216	Seeding							85T	196T	430T	119T	264T	
2217	Flush Streets (Misc.)							127T		8T	12T		
2218	Unclassified (other than etc.)							35.961T	27.650T	26.754T	43.213T	23.372T	
2221	Clean Up (Misc.)							2.033T	2.026T	3.160T	1.496T	1.595T	
2222	Kill Vegetation							1.049T	301T	425T	54T	68T	
2223	Trim or Remove Trees, Shrubs, etc.							3.526T	6.123T	3.814T	3.177T	4.819T	
2224	Plant Trees, Shrubs, Etc.							784T	1,061T	759T	909T	2,028T	
2225	Sand Bag Work							27T		47T			
2000 BLOCK PAVING SECTION													
2301	Brick Paving	3,005 sy	4,920 sy	5,294 sy	15,010 sy	5,884 sy	6,823 sy	1.87	1.66	1.48	1.54	2.14	1.679
2302	Granite Paving	6,433	10,943	9,556	5,799	16,456	9,837	1.81	1.74	2.00	1.71	1.92	1.855
2304	Remove Excess Filler	36	851	2,200	22	137 sy	649	1.40	.27	.18	.45	.47	.227
2305	Curb Setting	948 lf					948 lf	1.14					1.14
2306	Curb Resetting	5,134	2,753 lf	1,567 lf	6,083 lf	49,670 lf	13,041	1.44	1.64	1.83	1.18	WPA.39	.633
2307	Joint Pouring (Bl. Pav.)			183 sy	742 sy	700 sy	542 sy			.11	.15	.10	.124
2000 MACADAM SECTION													
Bituminous Conc. Patch (Cold)													
2401	On Asphalt	9,270 sy	5,628 sy	9,752 sy	2,294 sy	7,316 sy	6,892 sy	.75	.77	.68	.74	.53	.685
2402	On Macadam	270,738	389,198	324,415	159,711	202,107	269,234	.31	.27	.32	.42	.41	.330
2403	On Boulders	3,687	4,518	5,424	8,645	26,882	9,231	.34	.42	.34	.41	WPA.37	.375
2404	On Brick	2,850	3,546	1,524	22,481	10,256	8,131	.57	.43	.58	.37	.46	.420
2405	On Woodblock	20	237	337	1,373	10,386	2,471	.55	.65	.72	.64	.88	.844
2406	On Granite	10,148	6,803	8,298	18,728	18,964	12,588	.60	.61	.61	.51	.58	.570
2408	On Concrete	1,247	1,851	4,022	2,994	1,713	2,365	.83	.54	.79	.72	.79	.736
Surface Treatment & Retreading													
2421	Reg. Mac. Surf. Treatment	8,556	7,287	6,626	4,350	5,097	6,383	4.79	4.58	5.54	5.89	5.78	5.206
2422	Regular Macadam Oiling	hds. s.y.	hds. s.y.	hds. sy	hds. sy	hds. sy.	hds. sy						
		1,708	2,926	1,974	4,442	2,503	2,711	2.53	2.08	3.04	1.40	2.31	2.264
2425	Squeegee on Asphalt	32,531 sy	73,845 sy	8,407 sy		16,712 sy	32,874 sy	.05	.04	.05	.83T	.06	.045
2426	Squeegee on Concrete	62,074	70,436	15,078		9,510	39,275	.047	.03	.05		.05	.040
2427	Squeegee on Brick	39,148	16,599	4,741			20,163	.046	.04	.06			.047
2428	Squeegee on Granite	140,507	99,068	28,736	48,548 sy	39,097	71,191	.047	.05	.07	.07	.06	.054
2429	Squeegee on Woodblock			755	12,456		6,606			.07	.06		.061
Low Macadam Work													
2431	Macadam Base (Wetbed)	3,378	6,052	2,758	8,131	21,909	8,446	1.18	.69	1.00	.82	WPA.83	.844
2432	" (Penetration)				6	4,464	2,235				.37	WPA.32	.320
2433	" Top (Wetbed or Old Plain)	21,442	40,020	35,821	53,782	48,610	39,855	.20	.16	.17	.23	.19	.192
2434	Cinders		607	2,726	3,003	3,864	2,550	\$74.7	.10	.10	.13	.10	.109
Miscellaneous Macadam Work													
2441	Grading (Hand)	2,059	4,014	3,428	8,262	10,483	5,649	2.81	2.43	2.34	1.83	WPA1.92	1.710
2442	Grading (Machine)	49,349	23,525	54,113	79,665	193,086	79,948	.44	.44	.40	.31	WPA .29	.337
2443	Ditching	2,649	4,213	1,733	2,501	2,104	2,640	3.71	2.80	3.13	3.56	3.32	3.346
2444	Weed Cutting	hds. l.f.	hds. l.f.	hds. l.f.	hds. l.f.	hds. l.f.	hds. l.f.						
		641 lf	780 lf	417 lf	1,518 lf	1,621 lf	1,055 lf	13142T	12942T	12573T	11059T	11449T	
2445	Macadam Curb & Gutter							.39	.38	.57	.32	WPA .16	.308
2446	Planing (Road)				2,681	1,803	2,242						.722
					hds. s.y.	hds. s.y.	hds. s.y.						

Showing code system for basic maintenance operations and table of actual cost averages arranged for quick comparison



# CINCINNATI HIGHWAY MAINTENANCE COST REPORTFor Month Ending September 30, 1942

Type of Work Performed	Cost	Units Completed	Unit Cost	1941 Units Cost	1940 Units Cost	1939 Units Cost	1938 Units Cost	1937 Units Cost
<b>ASPHALT SECTION</b>								
2001 Asphalt with Asphalt.....	\$8,388.50	13,532 s.y.	\$ .62	8,066 \$ .49	8,657 \$ .58	13,438 \$ .62	14,882 \$ .63	1,096 \$ .54
2002 Boulder with Asphalt.....	108.11	355 s.y.	.31	....	16 1.02	80 .74	615 .66	16 .62
2003 Brick with Asphalt.....	....	....	....	....	....	4,383 .45	71 1.84	14 1.02
2004 Concrete with Asphalt.....	71.86	90 s.y.	.80	....	....	56 .59	....	....
2005 Wood Block with Asphalt.....	....	....	....	4,828 .56	4,810 .35	2,268 .40	3,057 .38	2,365 .38
2006 Granite with Asphalt.....	627.63	692 s.y.	.91	2,029 .43	647 .51	5 .75	606 .89	17,915 .81
2007 Macadam with Asphalt.....	1,911.49	5,506 s.y.	.35	....	....	....	30 .38	15 .21
2008 Base Work Only.....	2,889.32	2,483 s.y.	1.16	5,479 1.04	4,820 1.01	1,994 1.04	2,142 1.08	3,747 1.01
<b>CONCRETE SECTION</b>								
2101 Concrete Surface.....	92.30	14 s.y.	6.59	64 4.61	64 3.04	44 3.47	442 4.01	230 5.96
2102 Concrete Base.....	638.67	198 s.y.	3.23	97 2.83	81 4.13	83 3.98	186 4.66	239 3.70
2103 Crackfilling.....	13.95	3 hds. l.f.	4.65	....	11 1.52	122 .36	1 4.40	6 10.76
2104 Joint Cutting.....	....	....	....	....	....	....	....	....
2105 Concrete Surfacing.....	....	....	....	....	....	....	....	....
2106 Planing Castings.....	....	....	....	....	....	....	....	....
2109 Mud Jack Operation (Raising Slabs, etc.).....	808.76	2,241 s.y.	.36	983 .57	229 2.17	3,845 .41	3,028 .58	3,318 .39
2110 Reset Castings.....	203.39	19 ea.	10.71	51 11.96	16 9.75	23 5.10	3 7.66	10 8.74
2112 Concrete Curb & Gutter.....	209.90	187 l.f.	1.12	779 1.03	404 1.11	967 .99	138,009 WPA	643 1.20
2113 Drill Test Holes.....	27.76	....	....	....	....	....	....	....
2114 Break or Cut Out (Misc.).....	198.57	....	....	....	....	....	....	....
2115 Concrete Tunnels.....	....	....	....	....	....	....	....	....

Monthly cost summaries in this form are compared against long-range averages or against figures for the corresponding month in previous years

mulated in the month following the completion of the job, and are submitted to the Superintendent of Highway Maintenance immediately on completion. These job costs are detailed by "operation" so that the cost of each operation, as well as the total cost, is shown. In many cases, bills against other departments of the city or against other individuals, for work done for their account are prepared directly from these job cost reports.

## Costs on Street Cuts

The control and pavement replacement of street cuts, another function of the Highway Maintenance Division, is also controlled by detailed cost statements. Cost of this work is paid for by the permittee in advance, and the deposit is based on a schedule of unit prices which vary with the size of the proposed pavement cut and the character of the pavement. These cost reports are prepared and submitted monthly and are also used to reimburse the proper funds of the Highway Maintenance Division. The schedule of prices is developed from these unit costs which are carefully studied at the end of each year, and new prices adopted if costs indicate the necessity for a change in the price schedule.

The Division of Records also provides equally complete cost analyses of other activities of the Highway Maintenance Division such as street cleaning, sewer maintenance and cleaning, maintenance of bridges, viaducts, street name and traffic signs and markets, etc. Complete cost analysis is also provided for the Waste Collection Division detailed into collection and disposal of combustible and non-combustible wastes including set out and set back of cans and comparative operation costs of the three incinerators.

Cincinnati has had a city manager form of government since 1925. Colonel

C. O. Sherrill is City Manager and Mr. I. E. Root is Dir. of Pub. Works.

## Frost Prevention Report Spurs Subgrade Treatment

Comparatively small percentages of calcium chloride in soils will prevent detrimental heaving, the report shows, and "as a general average, it can be said that protection from frost heave in silt is afforded by 2 per cent calcium chloride, in clay by 1 per cent and in graded mixes by ½ per cent." This is the conclusion from the report in the 1942 Highway Research Board Proceedings covering the "Use of Calcium Chloride in Subgrade Soils for Frost Prevention," as investigated by F. O. Slate, research chemist at Purdue University.

Practical application of the findings has been undertaken by a number of highway and airport engineers, by impregnating frost boil areas with calcium chloride to prevent subgrade freezing, detrimental heaving and eruption, according to advices from the field.

Treatment of open surfaces and base courses of roads under construction is generally accomplished by uniform spread of flake calcium chloride over the surface to provide protection for 6 to 12 in. of depth and is worked in by scarification or similar means. Surfaced areas are being treated by back-filling a series of borings with a mix of 2 parts of sand or pea gravel to 1 part of calcium chloride.

Considerable interest also is indicated in soil treatment with concentrated calcium chloride solution which may be expected to disperse more readily, minimizing the need of scarification in the open-surface method, and the depth of the holes in the boring method.

The permanency of such treatment is not established, but tests show that there was very little loss of calcium chloride content after five years in base courses under black-top surfacing.

The calcium chloride industry is planning further research on the subject, and in the meantime is cooperating in special treatment work through its field representatives. Reprint copies of the Slate report are available on request to the Calcium Chloride Association, 4145 Penobscot Building, Detroit 26, Michigan.

## WPB Control of Small Project

War Production Board Regional Offices have been authorized to approve or deny construction projects involving production machinery and processing equipment when the dollar value involved is less than \$10,000.

This extension of authority to the Field Offices, announced Nov. 27, amends Order 708-20 which as previously revised on October 25, 1943, prohibited the processing of projects involving such machinery and equipment.

WPB Field Offices will "screen" equipment requested against records and knowledge of available equipment or facilities, and will review each case to determine whether or not an existing "E", "L" or "M" Order permits release of item requested.

For the next sixty days, if a special release or authorization is required, and approval of the project depends to a large degree on the availability of equipment under such control, the Field Offices will hold the case and forward the necessary forms to the proper division in Washington for its action. The divisions will return such forms to the Field Offices either approved or denied within three days of the receipt of the form.

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# The Recent Highway Meetings at Chicago

**W**AR has little dimmed the spirit of highway research, and it has stimulated road planning and look-ahead thinking as never before.

These two facts were evident at the highway meetings held in Chicago November 28 to December 3. It augurs well for post-war highway advancement that 450 engineers and officials were able to register for the Highway Research Board sessions and 700 for the American Association of State Highway Officials' meetings. A gratifying number also attended the two-day conference of the Association of Asphalt Paving Technologists, held concurrently.

analysis shows need for forward-looking, "attack" type maintenance which anticipates trouble and helps prevent or minimize deterioration, rather than the more usual "sustaining" or defensive type which patches after wear has occurred. "Attack" maintenance if properly planned can also eliminate much necessity for reconstruction after the war and will dovetail with plans for future construction to higher standards.

Positive road maintenance requires a closer liaison with the design and plans departments, to avoid spending funds that will be thrown away later. Under this conception, patching leaves the road not merely as good as it was,

defects; widening to get adequate width regardless of structural sufficiency; also question of what constitutes adequate width to keep traffic away from the edge, and what width of widening is necessary to get traffic on the widening strip.

**Flexible-type.** A lengthy report by A. H. Hinkle for the flexible-type maintenance subcommittee was recommended for publication as a War-time Problems Bulletin. This report includes the most complete table yet published showing standard-grade bituminous materials and their applications.

**Equipment Cost Data.** B. W. Davis (North Carolina) recommended that



Hal H. Hale, newly appointed executive secretary AASHO; Roy W. Crum, director Highway Research Board; Mr. Coddings, Calcium Chloride Assn.; C. L. Motl, maintenance engineer, Minnesota; Hershey Miller, Calcium Chloride Assn.

Tom W. Holman, chairman highway advisory committee, Washington; Fred Grumm, asst. state highway engineer, Calif.; Clinton S. Reynolds, member Washington state highway comm.; R. H. Wilson, office engineer, Calif.; G. T. McCoy, state highway engineer, Calif.

## Highway Research Board Notes

**Maintenance.** A new, positive attitude toward road maintenance is needed from here on according to a paper prepared by H. D. Metcalf, and read by A. G. Cochrane of Ohio. Entitled "Projective Maintenance," this

but stronger than ever to meet heavier expected traffic.

**Future Concrete Research.** Under the Committee on Salvaging of Old Pavements, rigid-type sub-committee chairman A. A. Anderson recommended research on resurfacing concrete (a) to secure an adequate structure and (b) to correct surface

the maintenance committee undertake a more active study of equipment cost data, including an analysis of highway department rental rates. Unit costs for parts, labor, rental, etc., will undoubtedly be different after the war, and today's widely diverging rates need bringing into line.

**Flexible-type Runways.** In a pa-



(Left): Colorado highway department table: D. W. Ormsbee, construction engineer; George L. Meffley, rep. Quickway Shovel Co.; Geo. E. Cranmer, mgr. of improvements and parks; D. N. Stewart, supt. of maintenance; Chas. D. Vail, state highway engineer; W. M. Williams, public relations; K. C. Vail, materials engineer; H. S. Dunwoody, planning and traffic engineer. (Right): Congressman J. W. Robinson (Utah), Chairman House Roads Committee; Brady Gentry, chairman Texas highway comm. (outgoing pres. AASHO); S. C. Hadden, chairman Indiana highway comm. (pres.-elect AASHO); Herman A. MacDonald, Mass., comm. of public works; Hal Sours, Ohio, director of highways; Congressman James W. Mott (Ore.), member House roads committee; M. J. Hoffman, Minnesota comm'r. of highways; R. N. Baldock, Oregon state highway engineer; F. E. Everett, New Hampshire commissioner; W. A. Rosenfield, Illinois director of pub. works; C. N. Purcell, California dir. of public works and highway comm. chairman



per, "Results of Accelerated Traffic Tests on Flexible Type Pavements," T. A. Middlebrooks and R. M. Haines of the U. S. Engineer Department showed that there is a wide variation in the allowable deflections which will give a satisfactory airport pavement, and that the allowable or critical deflection varies with the wheel load. Conclusions:

The problem of designing flexible pavements can be divided into two parts—to prevent shear deformation, and to prevent excessive traffic compaction.

The California Bearing Ration method, though not perfect, is still the best method of design, and one that has accomplished the primary purpose of obtaining generally thick bases for heavier plane loads over weak subgrades.

High-quality material with a CBR of at least 60 is generally required immediately beneath flexible airport pavement courses.

High construction compaction of cohesionless subgrades and bases is essential if flexible pavements are to be used for heavier planes without excessive settlement due to traffic compaction.

Greater compaction than can be obtained economically with present modern equipment will probably be necessary, likely requiring compaction above the Modified AASHO requirements adopted by the U.S.E.D.

It is extremely important to compact or drain saturated subgrades if composed of cohesionless fine sands or silts, to prevent a "quick" condition and break-troughs under traffic. LaFave (8) 12-16-43 13 ems 8 pt

Another excellent paper on flexible pavements was that on "Thickness of Surface and Base Courses," by Roland Vokac, technical advisor, Berry Asphalt Company. Pointing out that because of the variety of conditions of service, a flexible pavement had better be designed on the basis of a foot rule rather than a micro scale, he analyzes the three main design factors, which are the applied loads, stress distribution and subgrade bearing capacity. His formula indicates 4½ in. asphaltic concrete plus 6 in. of local aggregate base (bearing strength 27 psi.) on 8 in. compacted subgrade for a 60,000 lb. plane wheel loading at 75 lb. tire inflation pressure, assuming a 15 psi. subgrade. The stress distribution is based on assumption of finite zones of failure and stability under the concentrated load.

Award. Prof. Ralph A. Moyer, Iowa State College, received the annual Highway Research Board for a paper, "Motor Vehicle Operating

Costs, Road Roughness and Slipperiness of Various Bituminous and Concrete Surfaces."

**Pumping Joints.** "Pumping of Rigid Pavements in Indiana," by K. B. Woods and T. E. Shelburne. Extent and distribution of concrete pavements suffering from pumping action was reported after a comprehensive survey. Detailed surveys were also made on certain roads to determine the cause. There was noted a positive correlation between soil types and pumping, the occurrence being worse on moraine deposits where poor drainage was present in combination with plastic clayey soil.

Corrective measures suggested for slabs where pumping has already begun: keep surface water from entering the subgrade by sealing cracks and joints, and maintaining to eliminate edge ruts; provide good ditches and outlets; install subsurface drains, vertical drains of porous understratum exists; force sealing mixture under slab to fill voids created by pumping.

**Chemical Stabilization.** Whether addition of chemicals can help correct poor soils in connection with bituminous stabilization was covered by H. G. M. Fischer of Esso Laboratories. Except for lime the use of chemicals was seen to have little practical value. Liquids other than water produced greater load-bearing strengths, but generally

and practice on cement-treated base construction in California were reviewed by T. E. Stanton and M. Hoeem. Plant mix has been adopted after trail of various methods this paper described typical projects, and test data and gave suggested specifications.

**Calcium Chloride vs. Frost.** How does calcium or sodium chloride filter through soil? This question came in for attention in paper by Charles Slessor, research chemist, Purdue Joint Highway Research Project. Dealing largely with the problem of reducing frost heave by use of these admixtures, he found that the two materials migrate quite differently. Under the influence of capillarity and natural evaporation, sodium chloride tends to form a white crust on the unpaved road surface, hence is subject to surface washing by rain. This is not so with calcium chloride, which has greater moisture-attracting power and higher solubility.

With exposed fine-grain soils, both chemicals move laterally more by surface washing than by under see page.

In a coarse-textured soil, heaving was greatly reduced by adding only 0.33% of either. From 1.0 to 2.0% was effective in a silt which had heaved badly.

**Icy Pavements.** A sub-committee composed of J. E. Lawrence, chairman (Mass.), N. Hill and B. R.



W. W. Mack, chief engineer; M. Allan Wilson, testing engineer; W. B. McKendrick, Jr., asst. chief engr. (all of Delaware highway comm.); Mr. (and Mrs.) John N. Schroyer, Pennsy. secretary of highways, C. H. Buckius, chief engr. Penn. hy. dept.; Ernest Muncy, and A. G. Livingston, bridge engineer, of Del.

lower dry densities. In soil design several principles were noted, one being that the angle of failure and hence the angle of load distribution is not a constant 45°, but decreases as the soil layer is made thicker, toward 0° or simple shear. The load value varies according to the 1.5 power of thickness (compacted). The greater the number of soil layers in building up thickness, the greater the density and load capacity. Tensile rather than shear strength decides load-bearing capacity of compacted soil at point of failure.

**Cement-treated Base. Experience**

Downey (Mich.) presented a report on "Recommended Practice for Treatment of Icy Pavements." Perhaps the most complete and up-to-date summary of its kind, it discusses types of chemicals, specific character and grading of best abrasives and their treatment, proper storage and loading of abrasives, preparation of surface, application of abrasives and straight chloride.

Ice-treatment sand should contain neither fines or coarse material, but should be 100% passing ¾-in., 65% or more passing No. 16, 25% or less passing No. 50. Cinders are still



**ONE TRUCK LOAD OF ABRASIVES  
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Trucks are scarce these days. Don't use three when one can do the work. You can save two-thirds of war-scant supplies of gas and tires.

Manpower is scarce these days. Road crews are depleted by military service and by the lure of high industrial wages. One crew can accomplish the same amount of skidproofing as three, if the abrasives used are treated with calcium chloride.

Automobile skid tests made under impartial supervision show that  $\frac{1}{2}$  lb. of abrasives treated with calcium chloride is as effective

as  $1\frac{1}{2}$  lb. of untreated abrasives. Even in zero weather, the treated abrasives melt into ice quickly. They stay anchored in the ice . . . provide a sandpaper-like surface that gears the tires to the road.

Save trucks, tires, gasoline, manpower. Save two-thirds the cost of getting out your abrasives. Protect and hasten important war traffic by treating ice control abrasives with calcium chloride. Write for bulletin No. 27, "Skidproofing Icy Roads and Streets."

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Hugh A. Wallace, Asphalt Institute, Dallas; H. C. Hettelsater, manager of research, Harnishfeger, Milwaukee; Frank S. Gilmore, Asphalt Institute, Kansas City; R. P. Jones, Harnishfeger; Chas. P. Enland, FHA, Washington, D. C.



W. H. Root, Iowa Maintenance Engineer and chairman HRS maintenance department, with Geo. E. Martin of the Barrett Company



At Highway Research Board meeting: Lester A. Blackner, Utah road commission; Prof. Diefendorf, Univ. of Utah; C. A. Hogentogler and A. C. Benkelman, Public Roads Administration, Washington

voted as best. Washed and carefully graded stone dust, available in some localities, is covered with a suggested grading specification.

The paper covers chloride treatment of stockpile material in detail, recommending 40 to 75 lb. per cu. yd. Stock pile abrasives may contain 9 to 18 gal. of water per cu. yd. Given also were tables of chloride strengths for various temperature minimums.

Strongly recommended is more attention to the provision of bins or sheds to store and protect stockpiled treated abrasives. Bins should be accessible at two levels for loading and unloading, and located at intersections for maximum accessibility. Sheds should hold at least 100 cu. yd. and have the west side open for afternoon sun.

**Soil Cement.** This subject was represented by two papers, both by M. D. Catton and E. J. Felt, Portland Cement Association. "The Effect of Soil and Calcium Chloride Admixtures on Soil-Cement Mixtures," presented data showing that poorly reacting sandy surface soils can be improved economically so that they will react with cement satisfactorily (a) by diluting the soils with an admixture of clayey soil, limestone screenings, limerock, southern marls or similar materials, with the clayey soils being generally the most efficacious, or (b) by adding to the sandy surface soils a small percentage of calcium chloride.

These findings are of special interest to engineers in the Southeast where certain soils react poorly with cement. For each soil likely to present difficulties, a cost study is recommended to determine the most economical and practicable method of handling. The data indicated that about one part clayey soil admixture to three parts poor sandy soil will give good results. Soils otherwise requiring up to 18% cement were handled with 10 to 12% cement with this admixture. About a 50-50 admixture of clayey soils will often be needed in correcting if the admixture

soil is a lighter textured soil, limestone, limerock or similar material.

As an example of the outstanding improvement in reaction of an otherwise very poorly reacting soil when a small percentage of calcium chloride is added, test soils that would not harden with 26% cement by volume hardened well with 14% cement after adding 1% of calcium chloride by weight of dry soil. Optimum benefits of the chloride are usually obtained with a percentage ranging from 0.6 to 1.0 (2.5 to 5.5 lb. per sq. yd. 6-in. compacted depth); 4 lb. will usually suffice in correcting a poor soil.

Paper, "Weight-in-Water Methods of Determining the Moisture Content of Soil-Cement Mixtures in the Field," looked toward the solution of the problem of checking moistures rapidly on fast "train lane" construction where results are needed quickly in order not to hold up the job. The proposed method is based on the fundamental that a sample of soil-cement when weighed in water weighs the same regardless of its moisture content. The pycnometer-siphon method developed is much faster than the present one which requires drying samples over a burner.

**Post-War.** In connection with future committee work on post-war economic problems, Charles M. Upham urged that committee members be selected to represent a variety of

points of view. He stressed again the importance of the construction segment of our national income to national prosperity. The committee should develop facts on this topic, and on such subjects as best timing of post-war construction, engineering manpower, plans preparation, contract vs. day labor, effect on employment, and on use of borrowed money and savings in national construction and other financial matters.

The size of the post-war road job must be determined by the need for facilities in relation to other national needs. Inclusion of projects should be contingent on provision of needed construction to obviate made-work. Most economy will come through maximum use of unit-bid competitive contract system. The engineering supervision needed will help stabilize technical manpower. Employment benefits will be indirect as well as direct.

Augmented funds alone will not solve all our highway problems. Existing administration of state and local highway systems often has resulted in extravagances, and the systems and jurisdictions should be re-examined. The committee recognizes the difficulty of resolving administrative problems but believes that a long-range planning program guided by the above elements will foster a desirable continuity in administrative planning and direction.

## State Highway Officials Meeting

*Notes on some of the hundred or more excellent papers given at the Highway Research Board and American Association of State Highway Officials meetings, Nov. 28 to Dec. 3. Additional papers will be reviewed in the January issue, along with excerpts from papers given at the Asphalt Paving Technologists meeting.*

Out-going president Brady Gentry (Texas) in the opening session set the pace by outlining the current bill post-war highways before Congress, and the importance of highways in the war. He painted a vivid picture of what will confront us at war's end, and the acute reconstruction need that

is already expressing itself in a formidable maintenance job now. He warned again of the vital importance of drawing up plans at once. A mere restoration of roads will not be enough, since our highway system is outgrown. We must rebuild to much higher standards. Highway construc-



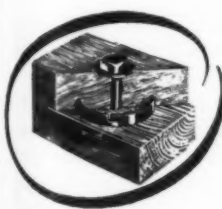
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tion needs totaling \$11,000,000,000 are foreseen and greater federal participation will be necessary. "Serious, constructive and immediate planning boldly done is the need. The next few months are vital months because they will determine whether we are to have the kind of highways we need."

Congressman J. W. Robinson (Utah), chairman House road committee: "The half-billion in post-war road projects now ready with plans is dangerously low...the total will rise to \$800,000 by next spring but that isn't enough...were the war to end suddenly the hard fact is that there is no such thing in America today as a public works program ready to go."

Thomas H. MacDonald, Commissioner of Public Roads, on the future highway program: The deterioration of highways and bridges and curtailment of replacement not repairs is currently the most acute problem... When history of war is reviewed serious students will question why, since land transportation is such an important part of war effort. Because of deterioration of both roadbed and equipment there may be a greater allocation of rail and highway maintenance funds soon.

As an example of the state highway need, 534,000 miles of road are normally covered by snow removal operations, for which there are 2,551 trucks and 3,768 other pieces of equipment valued at \$13,000,000. Parts to keep these units going to next midsummer will cost \$9,000,000.

The Procurement Division of the Treasury is taking over surplus federal equipment and will make it available to states at agreed prices. Recently zone conferences were held by the War Department Traffic Advisory Committee, in which army officials set up decentralized methods of dealing with transportation problems. Recently requests have been made to this committee for winter maintenance equipment needs. The outlook is for increased help through this channel, and highway departments have been urged to take up equipment and supply problems with the army's Zone Transportation Officers through the Committee.

How rapidly wartime road construction has dwindled is shown by figures from Mr. MacDonald: Miles placed under construction with federal participation: 11,842 in 1940, 8,645 in 1941, 1,869 in 1942, 722 in 1943. Mileage completed or placed under construction dropped less sharply, there being 2,376 miles completed in 1943.

Speaking on the part that state highway departments can play after

the war, Commissioner MacDonald believes that they must engage in broader fields than heretofore, enlarging their work to include coordination of municipal and secondary programs. The Federal role to remain that of using federal funds to fit the national economy and to stimulate local initiative.

He divided the post-war job into two categories, one being projects essential to restore war-worn facilities and catch up with current needs, the other "stand-by" program of projects to be built on a priority basis of usefulness, with employment as a consideration.

Major General Philip B. Fleming, Administrator, Federal Works Agency, on "Public Works Planning in War and Peace": Public Works, when soundly conceived, carry their own justification. We build highways, schools, hospitals and sewage disposal systems not just to make jobs but because we want good roads to drive over, education for our children, etc., etc.

The Federal government has in prospect about \$7,000,000,000 worth of construction. But very little has been completely planned, much is only partly so. Only about 600 million could be put into operation in the first post-war year. The recent executive order of the President, calling on various agencies to submit post-war construction plans to the Bureau of the Budget should hasten the Federal end of post-war preparation.

Surplus War Equipment. W. Vance Baise, North Carolina, in the Administrative Problems meeting, summarized committee thinking on the

### New ASSHO Officers

New officers for the coming year were elected by the AASHO as follows: President: S. C. Hadden, chairman highway commission, Indiana.

Vice-Presidents: Herman A. MacDonald (1st v.p.) comm. of public works, Mass.; Ezra Whitman, chairman commission, Maryland; C. W. Philips, commissioner of highways, Tennessee; H. G. Sours, director of highways, Ohio; Burwell Bantz, director of highways, Washington.

Treasurer: George H. Henderson, principal highway engineer, Rhode Island.

Members Executive Committee: M. J. Hoffman, comm. of highways, Minnesota; and J. S. Williamson, chief of highway commissioner, South Carolina.

Executive Secretary: Newly appointed to this post is Hal H. Hale, who has been assistant to the Secretary of American Society of Civil Engineers in charge of the Society's Washington, D. C., office.

desirability of distributing surplus war construction equipment to the states after the war. Basing his remarks on questionnaire returns, he advocated against indiscriminate distribution but favored absorption at a controlled rate. In recognition of the enormity of the problem a surplus

(Continued on page 72)

### AASHO Resolutions

Epitomizing the most serious questions before the highway industry and profession are the following resolutions adopted at the closing AASHO session:

1. The association favors the orderly adoption of surplus war equipment in foreign countries where road programs have been slow, to help create foreign markets and to minimize the disruptive effect of this surplus on the domestic market.

2. That a committee be appointed to look into the advisability of state highway departments cooperating in post-war maintenance of airports and flight strips; logical considering close relationship with highway transportation and similarity of airport and highway maintenance procedures.

3. That the association express its confidence in the Federal Works Agency as the instrument for cooperating with local governments in post-war plans preparation.

4. That each state return to the enforcement of the 1942 emergency agreement on war-time truck load limits, and return to pre-war regulations at once after the war; also that all states adopt the AASHO standard laws on size and weight as soon as possible.

5. That an expanded program of research correlation and utilization be adopted, in recognition of the large amount of important research now under way and the serious problems lying ahead.

# Arch Forms Detailed for Quick Handling

ONE of the effects of the war has been to bring back the old fashioned plain concrete arch for large culverts and small bridges. In the months when the reinforcing steel ran was tightest, more than one contractor's engineer or superintendent had to thumb through his handbook and brush up on special forms for such structures.

A careful job of form detailing that saved time and labor in the field was that used by the Horvitz Company, Cleveland, on a 15 x 18 x 212 ft. arch culvert, included in this firm's 1½ million dollar access road contract on the edge of Cleveland. Both outer and inner forms were built in 36-ft. panels, one set being used six times to complete the barrel. The outer form consisted of two curved sections which extended most of the way to the crown on either side, and a lightly constructed crown section. The lower forms comprised ordinary board sheathing, curved ribs sawn from 2 x 6's, and 2 x 6 double walers. After the lower forms were filled with concrete a plywood form was placed over the crown and concreting completed.

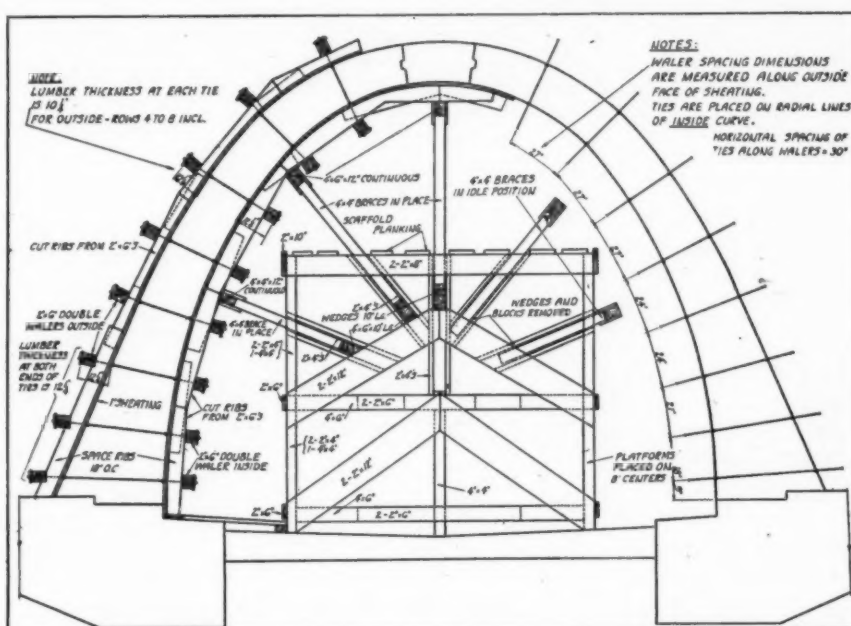
The inner form, similarly constructed, but faced with second-hand plywood, was erected to exact position and held in place by 4 x 4 braces as shown in the sketch and photograph. The interesting point of the scheme was the use of a scaffolding frame which supported a walkway within reach of upper form ties, etc., and also served as support for the form bracing. Bracing posts were adjusted to exact alignment with wedges and blocks. The inside form was moved by setting the bracing posts to idle position and sliding the form on rollers. The form design called for 5,000 lb. ties, but only 3,000 lb. ties were available and these gave no trouble. The procedure was to slide the forms, reset and concrete a section in the same day.

## L. A. Jobs Open

The Los Angeles County Civil Service Commission announces a nationwide search for applicants for the position of Administrative Assistant in the City Manager's office of the City of Burbank, California (\$400 a month) and Research Technician for the Los Angeles County Bureau of Administrative Research (\$265 to \$315 a month).



15x18x212-ft. culvert, showing forms in place



Men 25 to 55 years of age with at least 5 years' broad and extensive administrative experience in public administration, public engineering or business administration should investigate the Administrative Assistant position. Examinations for this position will be given in Burbank and other localities as justified by the number of applications received.

College graduates under 55 with 5 years' experience in Public or Private Administration should be interested in the Research Technician position for which there will be NO WRITTEN EXAMINATION. Full information and applications may be obtained from the office of the Commission, Room 102, Hall of Records, Los Angeles 12, California.

E. Roy Wells, Geneva, Ill., has been appointed chief engineer of the recently created Illinois Post-War Planning Commission. His work will be to direct project planning and act as liaison with federal, state and local agencies.



How stop lights are cantilevered out over the roadway on multi-lane highway south of Los Angeles. Particularly effective where existence of deceleration or acceleration lane necessitates setting post back from line of vision of through-lane motorists



# Editorial

## RESEARCH SERMON

**A**BOUT half way through the rather stiff and imposing array of papers in the design meeting Monday morning, Sam C. Hadden who was presiding, performed a sort of seventh inning mental stretch. "We'll spend more money on highway work in the next twenty years than we did in the last twenty," he ventured. "It isn't a question of selling or further establishing proved materials, but of *using* them intelligently and efficiently. Resurfacing of old pavements is a very important and difficult problem in our state and in others."

Mr. Hadden went on to say that in six Indiana highway districts, the district engineers reported six versions of what happened to roads that have gone bad. One of the most urgent problems is that of identifying the various contributing causes of roadbed or pavement failure in each instance. "We now have 48 rather highly developed state highway systems which constitute the greatest aggregation of test roads imaginable," he said. "We have hardly begun to analyze the service and condition of these roads as a means of learning how to build better."

"Each year in this country," Mr. Haddon went on to say, "there is a new crop of pavements that have reached their twentieth year—a dangerous and delicate age. What are we going to do with these, gentlemen? We should regard all existing roads as stabilized experimental highways. You know your loads and your conditions. Before we embark on the next cycle of highway construction, let's evaluate these factors."

## A LOT OF LITTLE JOBS

**T**ALK about superhighways and other big post-war projects has tended to obscure the fact that there are a lot of little "chore" jobs to be done after the

war. Picking up where they left off, alert county road commissioners, for example, will have things ready to replace or winden obsolete small bridges as rapidly as available funds permit. Here is a practical kind of project for post-war programming. Farmers and other road users will say amen. The jobs can be timed to fit employment need, beginning in localities where the need is greatest. Plans take little money or scarce engineering talent to prepare. No right-of-way worries, either, or delay because of dependence on some bigger project.

But this doesn't mean that there isn't advance work to be done. Existing structures must be inspected and condition data gathered to show why replacement is justified. Then come plans and specifications. Finally—and here's where some engineers have procrastinated—somebody (contractors, and maybe Uncle Sam) will want a bill of materials and a cost estimate.

What is your situation on small bridges and culverts?

## ANOTHER RESEARCH VICTORY

**S**CALING from intensive salt application needn't happen to concrete pavement built henceforth. Behind this important fact lies another long, patient job of laboratory and field sleuthing. Air entrainment has proved to be a characteristic by which scale resistance may definitely be controlled.

Now that special A.S.T.M.-recognized cements for scale resistant pavements are in production, there should be no lag in making full use of this development. For engineers this means adoption of recommended specifications and mixture designs. For contractors, it means merely learning a few precautions in handling the bulk cement and finishing the concrete.

(Continued from page 70)

property committee has been set up in Washington, consisting of five senators and five House members, to report to congress on additional legislation needed.

Contrasting this war's situation with that of 1918, he recalled that the last war speeded transition from steam to gasoline powered road machinery, and from wheel to track-laying types. This time, technology changes will be fewer.

Present equipment has deteriorated badly and will get worse before the war is over, and much surplus war equipment will be badly needed to get rolling on the post-war job while manufacturers are retooling. A high percentage of military construction equipment is of modified design or designed specially for speed, light-

ness or some other factor, and will not always be well adapted to peacetime tasks.

Of special interest is the equipment needs in the vast amount of road maintenance and repair work accumulated. All-wheel-drive trucks, tractors, graders and other units will fit in here, along with truck-mounted shovels. Secondary road maintenance will absorb large quantities of such units, making it possible to step up the general level of local road upkeep. Disposition of war equipment will speed conversion of the industry to diesel power.

A large percentage of present civilian equipment is over 13 years old (shovels 37%, trucks 23%, crushers 52%, etc.). We've now gone two years without normal replacement, and this may stretch to 4 or 5 years before

normal buying can resume. While the quantity of war equipment is large, big also is the mileage of roads to be restored and kept up. This country has over 1½ million miles of unsurfaced and 770,000 miles of gravel or similar roads, many of which never had adequate attention.

Mr. Baise suggests that a scale of reasonable charges be worked out in the sale of war equipment, under which states can buy as needed without being tempted to "take all they can get" as in the case of dumping. Fifty per cent of normal valuation is suggested as a starting point for discussion. Distribution through the Public Roads Administration is advocated, a special AASHO committee to be assigned to go into the details, which should include provision for re-

(Continued on page 95)

**Care and Repair  
in Shop and Field**

**CONSERVATION ROAD**

# CONSTRUCTION EQUIPMENT MAINTENANCE

A SPECIAL SECTION OF ROADS & STREETS





## The Navy knows the Answers

In our Navy, the world's most formidable fighting machine, Diesel-powered craft of all kinds are lubricated with Standard of California's RPM DELO. The answers in this naval quiz tell you why. They'll solve your problems on how to squeeze more efficiency out of your Diesels—and cut maintenance costs.

### Q. Can a submarine drown in air?

**A.** Yes. Her Diesels "breathe in" great quantities of air which cause ordinary oils to turn gummy, stick rings and hasten engine failure. In today's subs, RPM DELO eliminates this ring-sticking, reduces sludge and deposits—greatly increases cruising range.



### Q. How do you put a bone in the teeth of a DE?



**A.** Powerful Diesels put that speed wave under the bow of a Destroyer Escort. With RPM DELO lubricating her big engines and keeping them at top efficiency, a Destroyer Escort can sprint like a race-horse, even at the end of a long convoy trip.

### Q. What is the most explosive part of a minesweeper?

**A.** Her engine. Thousands of times a minute, fierce explosions sear her cylinders. But they're safe with RPM DELO because it contains special additives that make it cling to hot spots, give constant point-of-wear protection, even under most severe conditions.



### Q. What is the most important duty of a landing barge?



**A.** To keep in action—because a beachhead breakdown could be disastrous. RPM DELO in a landing boat's Diesel gives it extra protection against breakdowns. RPM DELO often cuts Diesel repair bills in half, doubles the time between overhauls, minimizes wear.

RPM DELO is marketed under the following names: RPM DELO • Caltex RPM DELO  
Kyso RPM DELO • Signal RPM DELO • Imperial-RPM DELO • Sohio RPM DELO  
CONCENTRATE



**STANDARD OIL COMPANY OF CALIFORNIA**

Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your vicinity

# Equipment Maintenance

## Real Monthly Equipment Check-Up

Basis of preventive equipment maintenance by Minnesota highway department

USE of a "no-buck-passing" report system on equipment repair needs, and holding of individual operators strictly responsible for reporting the health of their machines, are features of the Minnesota state department of highway's equipment maintenance routine. Sixteen well-equipped district shops and a headquarters repair and machine shop at St. Paul have the job of keeping in service the state road equipment, which includes 812 trucks, 30 tractors, 162 motor graders, 202 pull-type graders, 258 passenger cars, 59 motorcycles, 1186 snow plows and wings (all types), 300 sand spreaders, and other miscellaneous items totaling 4269 units.

Because of the state's size each maintenance district has long since been equipped and staffed as a self contained unit except for special repairs. In the past much motor overhaul work was farmed out to commercial garages, but since the war it has become necessary to do more and more major engine repairs in department shops.

In each district shop there is a district mechanic who reports to the district maintenance engineer, and works closely with a field mechanic out of headquarters. Many minor repairs are made by the field mechanics, who travel about in a pick-up with light tools. All operators report monthly or oftener on their assigned machines, a copy going to the district shop and duplicate copies to St. Paul headquarters. The central office studies these reports immediately for trouble trends, and uses them to keep district men on their toes. This check also helps spot mechanical trouble quickly and eliminates buck passing on the part of operators. When a breakdown occurs due to lack of prompt shop cooperation, the operator's skirts are in the clear if his reports have shown the need for repairs.

### Monthly Inspection Rules

Included in the department's latest equipment manual are instructions



C. L. Mott, maintenance engineer (right), and Dwight Hayden, shop chief, snapped at the state's headquarters shop.

that all automotive equipment units shall be thoroughly inspected and adjusted once each month, except that units may be omitted if used less than 80 hours or 500 miles since last inspection.

### Inspection Schedule

The shop foreman plans and posts on the shop bulletin board each month an Inspection Schedule, showing date, class of inspection (monthly or semi-annual) and marks thereon the completion of the inspection and the adjustments or repairs.

While it is understood that circumstances may not permit this schedule to be strictly adhered to, no inspections may be omitted except as noted above.

Inspections of equipment which is not motorized, such as plows, for example, are reported on the regular forms, leaving blank the items which do not apply but indicating adjustments or repairs needed, if any, in detail, in the spaces at the lower part of the report form.

The monthly instructions are to check on the following items:

### Monthly Inspection Instructions

**Engine:** If engine is dirty, note on report. Remove, clean, and adjust spark plugs. Check plug color. Tighten cylinder head bolts with torque wrench. Check and record compression with throttle wide open. Tighten manifolds. Check muffler and exhaust

line. Check and adjust valve clearance. Tighten motor support bolts. Check and repair cooling system. Check and adjust generator. Adjust belts. Check breaker points and timing. Clean carburetor, fuel pump, fuel filters, oil filter, air cleaner and breather cap. Clean, balance, and time Diesel injectors. Tighten all line connections. Check starter operation. Check governor and record R.P.M. Record oil pressure at governed speed.

**Battery:** Test each cell. Record lowest hydrometer reading. Clean and grease terminals. Tighten hold-down bolts.

**Clutch:** Check and adjust for clearance and travel. Report slip or grab.

**Transmission:** Report noisy gears. Check universal joints.

**Front Axle:** Check for play and wear. Check toe-in. Service shock absorbers. Check springs, clips, and shackles. Tighten wheel nuts.

**Steering:** Check rods, arms, and links. Adjust play and tighten.

**Rear Axle:** Check back lash. Check for loose wheels. Tighten wheel nuts. Service shock absorbers. Check springs, clips, and shackles.

**Brakes:** Check action on road. Fill master cylinder. Check for leaks. Adjust. Check booster action.

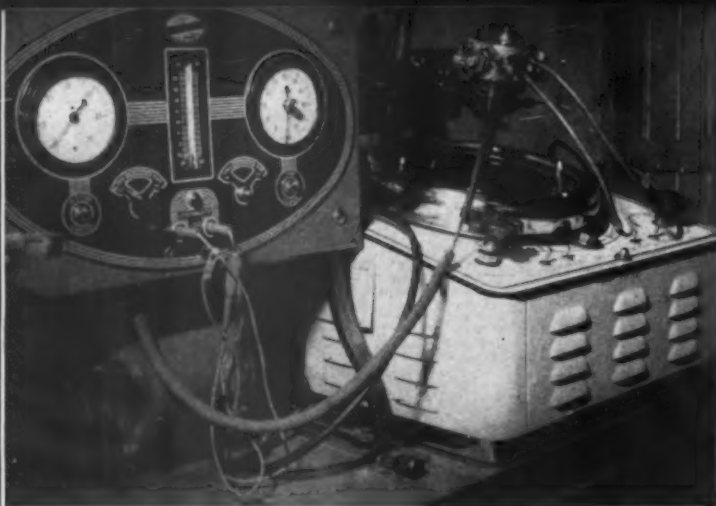
**Hydraulic System:** Check leaks. Fill reservoir. Test pump action. Repack piston rods if necessary.

**Body and Cab:** Tighten all assembly connections, including hoist hinge brackets. Replace all cracked or broken glass. Note appearance and paint condition.

**Tires:** Report cuts, bruises, and general condition. Check pressure. Change positions at 5,000 miles. Replace if needed. On report show position of tires needing repairs. Example: LF (left front), IRR (inside right rear).

**Accessories:** Check and adjust or repair dash instruments, lights, wipers, horn, mirror, jack, and tools. Check heat indicator for accuracy. Lubricate speedometer cable. Check first aid kit, fire extinguisher and manual. Inspect service record en-





tries. If entries are incomplete, note on report.

**Road Test:** Make final adjustments.

### Semi-Annual Inspection

**Engine:** If engine is dirty, note on report. Clean thoroughly. Remove cylinder head, oil pan, distributor, generator, starter, carburetor, and fuel pump. Clean carbon. Grind valves if needed. Adjust tappets. Check bearings, pistons, and rings for wear and condition. Replace if necessary. Recondition generator, regulator, starter, carburetor, and distributor. Check all engine wiring. Test coil and condenser. Clean, balance, and time Diesel injectors. Clean fuel filters, breather cap, oil filter and air cleaners. Clean and adjust spark plugs. Check plug color. Replace if necessary. Reassemble engine, using torque wrench for head. Tighten manifolds. Check and repair muffler and exhaust line. Tighten motor support bolts. Flush radiator. Check and repair cooling system leaks. Replace hose where necessary. Tighten all line connections. Tune engine. Check governor and record R.P.M. Record oil pressure at governed speed. Check and record compression.

**Battery:** Test each cell with analyzer. Charge or replace, if necessary.

Record lowest hydrometer reading. Clean and grease terminals. Tighten hold-down bolts.

**Clutch:** Check wear, re-face if necessary. Check and adjust clearance and travel.

**Transmission:** Check for noisy gears. Repair and adjust. Check and repair grease leaks. Flush and change lubricant.

**Front Axle:** Check for play and wear. Remove wheels. Check and adjust or replace spindle bearings. Check camber, caster, and toe-in. Check brake lining for condition; replace if necessary. Check brake cylinders for leaks. Clean and repack bearings. Check springs, clips, and shackles. Replace wheels; adjust bearings and tighten wheel nuts. Service shock absorbers.

**Steering:** Check rods, arms, and links. Re-bush and replace worn parts, if necessary. Flush and refill with lubricant. Adjust play and tighten.

**Rear Axle:** Remove wheels, check condition of brake lining; replace if necessary. Check adjustment and condition of gears and bearings. Check brake cylinders for leaks. Clean and re-pack wheel bearings. Check springs, clips, and shackles. Service shock absorbers. Flush and replace

gear lubricant. Replace wheels and adjust bearings. Tighten wheel nuts.

**Brakes:** Check for leaks. Flush system with pressure bleeder. Check valves, booster and air cleaners. Check booster action. Check and adjust brake action.

**Hydraulic System:** Fill reservoir. Test pump action. Re-jack piston rods, if necessary. Change oil, if required, for correct seasonal viscosity. Clean filter.

**Body and cab:** Tighten all assembly connections, including hoist hinge brackets. Replace all cracked or broken glass. Note appearance and paint condition. Clean thoroughly. Check door and window operation. Repair cushions, fenders, grilles, splash pans, and running boards. Paint, if required.

**Tires:** Check condition carefully. Remove and repair or replace all tires needing repairs or re capping.

**Accessories:** Check and adjust or repair dash instruments, light and wiring, wipers, horn, mirror, jack, and tools. Check heat indicator for accuracy. Lubricate speedometer cable. Check manual, first aid kit, and fire extinguisher. Inspect service record entries. Report if incomplete.

**Road Test:** Make final adjustments.



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### \$1,600,000 Yearly Cost

The state's annual equipment budget in recent years has been about \$1,600,000. Equipment costs are charged against highway funds on a rental

basis, as required by a state law. State highway maintenance funds must be used for maintenance in Minnesota. Surplus maintenance money cannot be used for anything else.

## Seen in Minnesota State Highway Shop at St. Paul

(See accompanying photographic illustrations taken by a ROADS AND STREETS field editor.)

1. In the motor test room, a Distributoscope for testing the timing accuracy of distributors is part of an extensive outlay of precision equipment. This unit has paid for itself in time saved in finding grounds in distributors and in making more accurate adjustments. The state's recent practice is to set all distributors 2 to 4 degrees late, to offset the high knocking tendencies of low-octane gas. (New distributors are checked, too; occasionally found out of time.) Test room also includes a pump for testing windshield wipers, automatic spark advances, etc., revolution counter for setting governors and for checking idling speeds on cars that must have carburetors set to known idling speeds; generator-starter tests stand with modern instrument panel, including 5-hp. motor.

2. Salvage work. The state has met the parts famine by carrying the salvage of starters, carburetors and other units to the limit. Here is part of a recent district office round-up of old units. Carburetors especially are gold mines of levers, links, screws and other small parts now extremely difficult to get.

3. Another labor-saver and an aid to accurate work is this fountain and tub for solution-cleaning small motor, carburetor and generator parts.

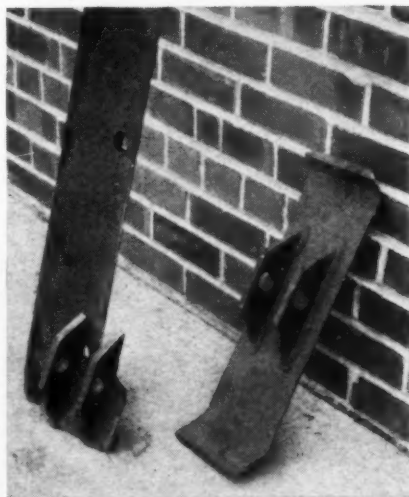
4. Cushions and upholstery for trucks and cars are overhauled by an expert, full-time upholsterer who has a power sewing machine and other modern equipment. Broken springs are repaired, coils are cross-tied permanently in proper position, cushions rebuilt with auto bats, cotton lining and new cover material. Truck drivers especially appreciate this service! The best kind of "duration" maintenance.

5. Tire height? This device aids quick, accurate measurement of the diameters in matching up tires for duals.

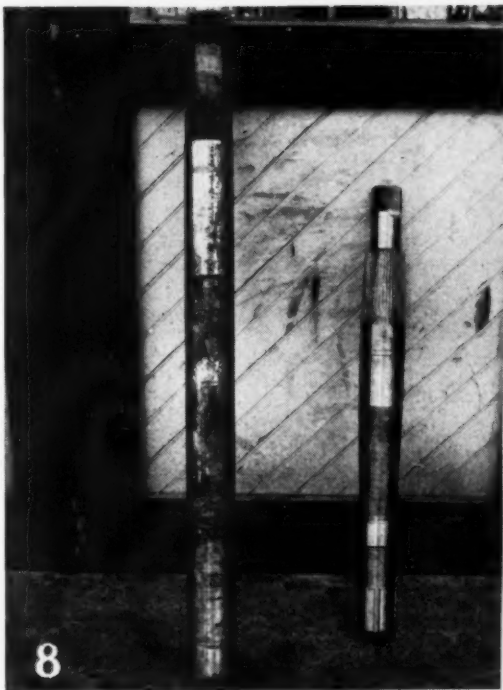
6. Extra snow-truck wing-masts, made up during the summer in the state's St. Paul shop.

7. Nice welding job! The back end of a tank truck, showing how a new reinforcing plate was inserted to replace an old plate head.

8. Motor grader axle (right) was turned from part of an old tractor axle. Half of the old axle, of 31-40 michrome steel, was machined to the new design as follows: rough turned—splines on both ends, as shown, cut with a milling machine set up on a dividing head to space properly—bearing surfaces finish ground on a radial grinder—threads cut on a lathe.



**SALVAGE YOUR SNOW PLOW SHOES!** Here's how Sangamon County, Illinois, does it. Photo shows worn shoe section of worn grader blade, and another shoe after half-soling with a similar piece of blade steel. Roy V. Tilly, county superintendent of highways, has worked tricks like this to the limit



### Preventing Welding and Cutting Fires

To instruct users of welding and cutting equipment in reducing potential fire losses, the International Acetylene Association has prepared a convenient, 16-page, pocket-size booklet entitled "Preventing Welding and Cutting Fires." Obtainable from International Acetylene Association, 30 East 42nd Street, New York 17, N. Y., or any manufacturer of oxygen, acetylene, carbide, or welding and cutting equipment.

Persons engaged in the manufacture of light-weight aggregates, ready-mixed concrete, and pre-mixed bituminous concrete are eligible to use the MRO symbol and the AA-2 preference rating assigned by CMP Regulation No. 5 to obtain maintenance, repair and operating supplies.



## "All Out" Equipment Distributor

Wm. Ziegler Company typical of machinery firms today busy overhauling Army equipment and helping contractors and road departments keep going

**C**ONSTRUCTION equipment distributors have always done a large volume of overhauling, for owners or on used equipment. In recent months the experience and facilities built up in their peacetime service made it possible for them to do a tremendous wartime job. Collectively they have turned ready facilities to the efficient overhauling of tens of thousands of construction units for military duty all over the world. . .

Little less important, they have helped dig up parts and replacement machines and give mechanical aid to

state, county and city departments in their efforts to keep up essential maintenance. . .

Active in developing better machines for peacetime road and street construction, distributors have contributed ideas for new machines or for adapting available equipment for war service. And they have worked out their share of shop emergency kinks for keeping old equipment in service long beyond its normal life. . .

### Ziegler a Busy Place

These are some of the thoughts that

flashed through the writer's head as he dropped into Wm. H. Ziegler Co.'s, Inc., place in Minneapolis one day recently. "Care if I take a look around?" was our request, and in a few minutes we began to get a fresh picture of an equipment dealer converted to war. For Ziegler, in common with numerous of his brethren, is not only doing everything possible to aid highway departments and contractors, but has taken on a contract to overhaul Army-owned machinery. His tractor and allied department and his construction equipment department (shovels, mixers, pumps, etc.) were clanking and banging away double-shift in greatly expanded shop quarters.

His parts department was greatly expanded, too. Space formerly used for displaying equipment now houses new stacks of parts bins and racks holding \$150,000 to \$200,000 in factory parts. All you need here is the right priority!

Used parts stocks likewise have been stepped up. All parts and assemblies replaced in overhauls, if not worn to the junk stage, are refurbished and thrown into the right pigeonhole. Many a snow plow in the Minneapolis region will be able to keep going this winter as a result of this systematic salvage by your dealer friends.

As with other Army repair contractors, Ziegler's work is done to four standards, based on inspection of the used machine when received. "AA" overhauls make the machines practically new, for overseas duty. "A" jobs for domestic troop training, etc., include extensive rebuilding, with some old parts remaining. "B" is for units dinged up for light duty around army posts, etc.

### Overhauls Thorough

A typical "A" tractor overhaul is very thorough. For example, a Caterpillar on the shop floor has just been given new tracks and rollers, transmission overhaul, new leathers, rings and seals for dozer jacks, all new seals on the final drive, radiator checked and leak soldered, new rings in the motor (and, it so happened, new main bearing, too), and a G.I. paint job.

To speed up wartime overhauls the Wm. H. Ziegler Co., Inc. has designed and installed power track shoe wrenches in their Minneapolis main



Power track-shoe wrench, designed by the Ziegler staff and built from salvage materials and parts. Boy, does it do the job!

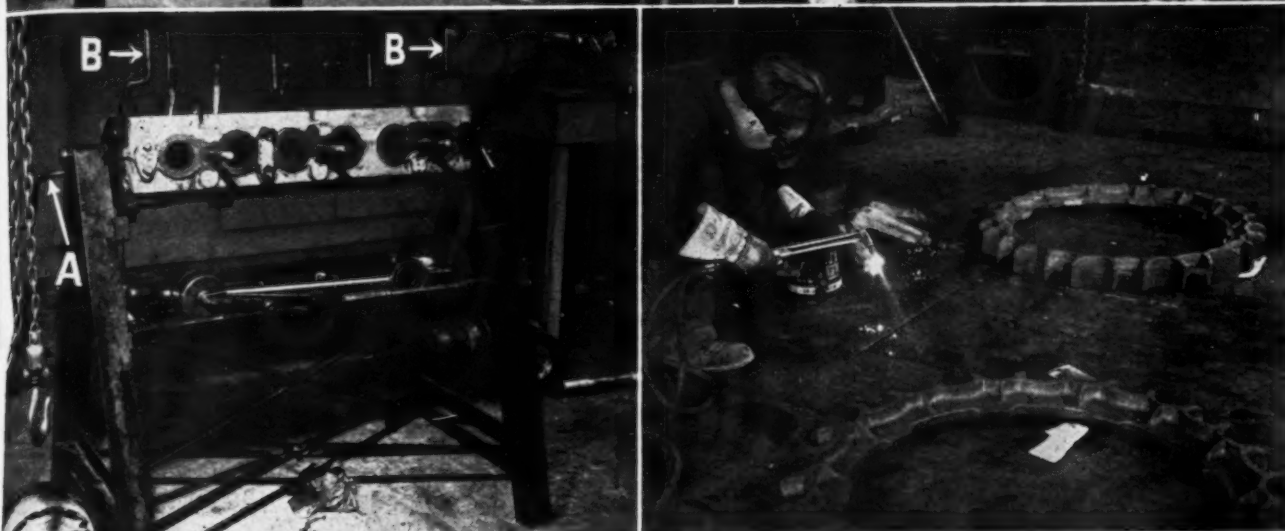
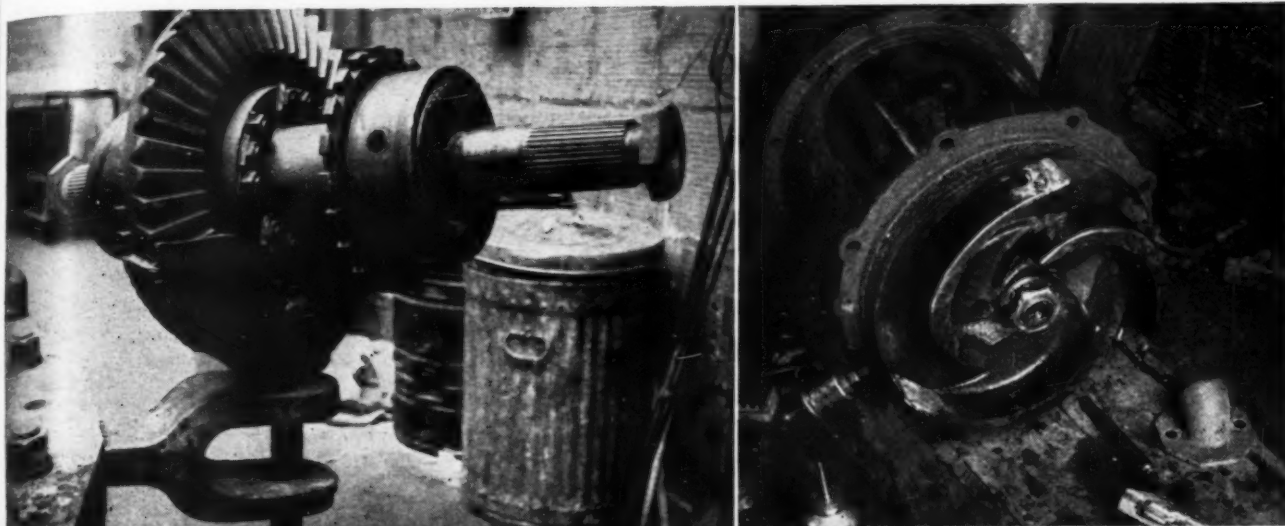
In Minneapolis shop of Wm. H. Ziegler Co., busy these days overhauling Army equipment



(Upper and built new. (Lever (A) hold the spokes

shop at Duluth outfit v or salv electric

(Left):



(Upper left): The handy bracket setting into the clevis is for holding a Caterpillar steering clutch shaft while working on it. Also designed and built by the Ziegler shop men. (Upper right): Bronze welding and regrinding the tips has made the impeller of this 6-in. pump good as new. (Lower left): Stand for holding motors during grinding of valves, designed and built by Ziegler's shop foreman Roy Rasmussen. Hand lever (A) at left is pulled out and pushed into either of two positions, locking motor either rightside up or upside down. Two bolts (B) hold the block securely in place during work. (Lower right): Burning away tractor sprocket teeth and welding new rim castings onto the spokes is a well established wartime salvage procedure. Ziegler has been doing it wholesale.

shop and also at their branch shops at Duluth and Crookston, Minn. Each outfit was made entirely from scrap or salvage materials except for the electric motor. For instance the Min-

neapolis unit comprised a rear-end from an old car, part of an axle shaft, old car transmission, old clutch, shop-made frame. This machine takes off tight track bolts that an air wrench

can't budge, cuts bolting-up time for a set of tracks from a day down to 2 or 3 hours. It is designed so that in bolt tightening the clutch gives when the bolt is about tight enough,



(Left): Device that many a contractor or highway department could use profitably is Ziegler's rack for storing wire rope drums. Metal drum shafts roll along two rails as shown. (Right): Portable track press, designed for use in the field.



the final tightening being done by applying slightly more clutch pressure with a lever.

The most recent addition, however, is a piece of equipment devised and built for handling complete crawler tracks in the operation of welding and building up of shoes without detaching shoes from the tracks.

This equipment and also some of the many welding and other shop activities in progress at the time of our visit are shown in the accompanying photos.



Ziegler stores second-hand parts as systematically as new parts. Parts warehousing for quick delivery is a distributor function equally valuable in peace and war

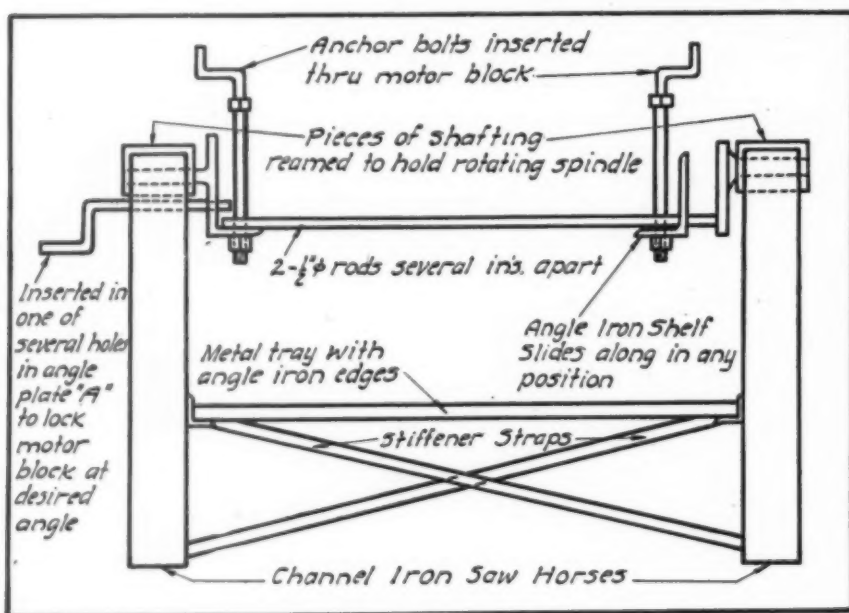


Fig. 1—Details of motor stand built of salvage materials

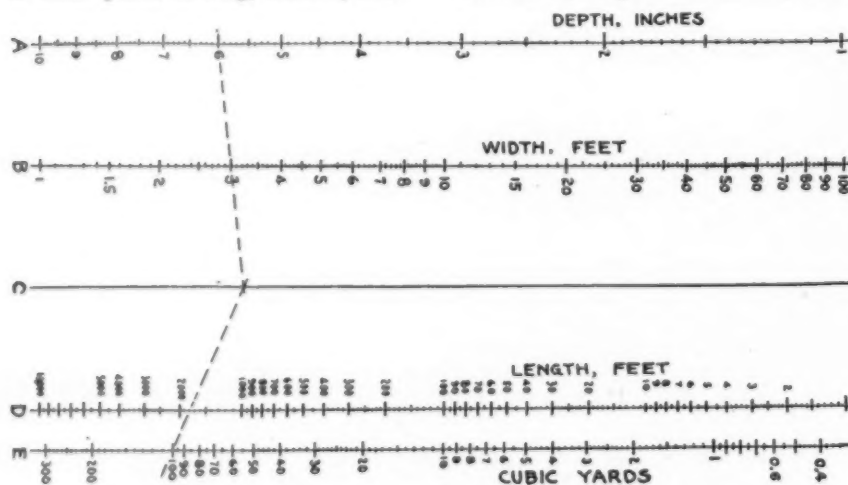
### Chart Gives Yardage on Shallow Excavations

By W. F. SCHAPHORST, M.E.  
Newark, N. J.

We often want to know the number of cubic yards in long, narrow, shallow

excavations. The depth is then usually given in inches and the width and length in feet.

The chart herewith has been developed purposely to take care of excavations of that kind. The depth, Column A, is given in inches, while



the width, Column B, and length, Column D, are given in feet.

Simply run two zigzag lines across the chart as indicated by the dotted lines and the number of cubic yards is instantly given in Column E.

For example, the dotted lines drawn across the chart show that if we have an excavation 6 inches deep (Column A) by 3 ft. wide (Column B) and 1,800 ft. long, (Column D) the number of cu. yards will be found to be exactly 100, in Column E.

Merely run a straight line through the 6, Column A, and the 3, Column B and locate the intersection in Column C. Then from that point of intersection run through the 1,800, (Column D) with another straight line and the intersection with Column E gives the answer as 100 cubic yards.

But that isn't all. The chart will also take care of deep excavations. Thus if the depth is 60 inches instead of 6 the same dotted line will give the answer as 1,000 cubic yards instead of 100. That is, if a digit is added in Column A a digit must also be added in Column E. Likewise if a digit is added in Column B a digit must be added in Column E.

Thus the same dotted line would show that for an excavation 60 inches deep by 3 feet wide and 1,800 feet long the number of cubic yards would be 1,000. Or, if the depth is 6 inches, width 300 feet, and the length 1,800 feet, you will have to add two digits in Column E because two digits were added to Column B thereby giving us 10,000 cubic yards in Column E as the correct answer.

It is therefore evident that this chart will easily take care of almost any rectangular excavation and it will give results that are surprisingly accurate.

# How to Keep Your Excavators Going

Moving more dirt at lower cost; old and new ideas for short cuts and savings

**T**HE efficiency and long life of your excavator depend primarily on the quality built into it, the operator, and YOU. Among the suggestions presented in this book you may find some that will help toward keeping your excavator operating steadily and at maximum output. Many of the ideas listed may be old timers you've used for years—we've tried to make a fairly complete list to help you check over your basic excavator operations in an efficiency review. You may find even some of these old timers are being neglected, and others will suggest variations applicable to your jobs.

As you study your operations from the standpoint of efficiency and long life, remember that you are considering two primary factors, economy of distance and economy of time. Speedline your operations to move material from the bank to the dump with the shortest number of motions in the shortest distance. Analyze your cycle time, study delays, figure your percentage of job efficiency.

Use the following check list to help in your search for Victory short cuts and savings.

## Suggestions for the Boss

*Give Your Operator a Chance to Be a GOOD Operator*

Figure enough trucks to handle your shovel's capacity on the length of haul worked and then add one or two (depending on length of haul) to insure continuous loading.

Set up a traffic system that keeps hauling equipment rolling with even distribution. Avoid bunching. Plan servicing to release trucks from shop at regular loading intervals to start shovel morning and noon.

Double-spot if bank layout is suitable. Spot trucks in close to bank for short-swing loading and always at same spot relative to excavator so the operator doesn't have to "hunt" for the truck. Spot in line with swing and so dipper doesn't have to pass over cab. Setting a log or tie for a spot "bumper" may help.

Powder is cheaper than equipment—keep bank well blasted if blasting is necessary. Be sure blast holes are deep enough to break out toe well under grade. Scratching out half filled buckets in twice the normal loading time divides output by four and multiplies maintenance by six.

Order parts well ahead. Every possible effort should be made to avoid unnecessary wear and over-

[From booklet, "Ideas to Help you keep your Present Excavators Going," published by Bucyrus-Erie Company, South Milwaukee, Wis., and available on request.]

stress. See that repairs parts are ordered as soon as need is indicated and make repairs promptly. Putting off a necessary repair job usually involves extra stress on adjoining parts, slows down production because operator must favor the weak part, and often means an expensive mid-shift breakdown, that may break other parts or injure employees.

Buy good grade lubricants and genuine repair parts. Keeping equipment well painted not only protects it from weather but also encourages the crew to operate carefully, keep the machine clean and well adjusted. The army paints all lubrication fittings red—it's not a bad idea.

Give your personal attention to insuring clean fuel and clean lubricants. Be sure these come to the job clean, are kept clean in storage, and stay clean when applied on the machine.

Give the boys a pat on the back when they deserve it!

## Suggestions to the Operator

**STEADY DOES IT!** Take pride in your skill and your machine

Steady output wins the war. Watch the monthly rather than daily records. Take a comfortable pace and stick to it. The idea is to move dirt, not to put on a good show!

Before you start, adjust your seat to fit your arms and legs. Each shift operator is entitled to his own adjustments. The comfortable operator gets more work done, more safely and with less wear and tear on the machine.

Develop your overlapping to get a smooth flowing, rhythmic cycle. Remember you're working for the shortest and smoothest travel from bank to dump. Work your shovel bank with "open ends" so you can swing out as you retract.

Check your cycles against the clock and work out the combination that gives you most passes AND DIRT per minute without abusing the machine. The one that looks the fastest

## JAEGER "Sure Prime" — Pumps that Exceed Their Promises



The only pumps that, for years, have been individually tested and certified for vacuum, capacity, pressure and regularly exceed their guaranteed performance—with up to 5 times faster 100% automatic priming, high capacity under adverse conditions, thousands of hours of extra service. Self-cleaning shells, replaceable liners, longest life seal, oversize shafts—for high pressures, continuous heavy service.

Sales—Rentals—Service in Over 100 Cities

THE JAEGER MACHINE CO., 223 Dublin Ave., Columbus, Ohio

CONTRACTORS' PUMPS, MIXERS, HOISTS, PAVING EQUIPMENT



may not dig the most dirt. Remember, only heaping dippers count!

If you're unlucky enough to have an old fashioned machine on which you have to "strong-arm" the controls, do your best with adjustments. Then get together with your other shift operators and have your master mechanic out to show him what you mean—maybe he can work out some changes of leverage or springs to help you.

Teach your oiler to keep a neat, clean machine. Adjustments are easier to make and hold on a clean machine; it's easier to see troubles start, it's safer and more comfortable to work in. Take pride in good housekeeping.

When the trucks bunch up, speed up loading on the first ones. Do your part to keep them rolling with even spacing.

Keep busy when you are waiting. Move up, loosen the bank, clean up the corners, do any necessary adjusting.

#### Watch Adjustments Daily

*Keep 'em sweet—it saves you work and the boss money. The best of machines can't do its part with sloppy adjustments*

*Clutches:* Adjust at normal operating temperature. Reverse bands

(if reversible) to distribute wear when dead-end has worn off about one-third. Do *not* use compounds on bands. Always keep bands and housing clean. If pins and holes on control levers are worn install new over-size pins or build up parts by welding to remove play. Clutch bands require adjustment more frequently when new than after they are properly worn in.

*Brakes:* Don't let bands wear down till rivets score housing. Adjust carefully to get a sure safe grip. ALWAYS be sure they release freely and evenly all around. Don't "ride" the brake pedal! Keep pedal springs just tight enough to raise pedal to top position.

*Boom angle:* Shovel booms are usually worked at 45° to 50° for general digging. Lowering gives a longer cut in a shallow bank at a better hoist rope angle. You, of course, also lower for extra reach. Raising increases dumping height and improves stability for heavy digging. Keep boom-hoist always in good adjustment. Test occasionally when on work where boom hoist is not used. Check safety devices regularly.

*Dipper-trip:* Replace latch and keeper or rebuild metal when neces-

sary. No dipper-trip mechanism can function properly with a worn out latch. Use the shortest latch adjustment that will catch and hold securely. A good power-trip pays dividends. Keep adjustments *right*, always.

*Dipper pitch:* Often neglected, the right pitch is always worth while when you are digging a like bank for several shifts or more. In general the pitch should provide a line of penetration parallel to your average angle of bank. If you are having trouble with tooth breakage check pitch for possibility of taking stresses of hard digging more directly in line with teeth.

*Crowd rope or chain:* Keep your crowd adjustments fairly snug. Combine crowd action with hoist action to secure easy penetration. Remember the purpose of the crowd is to apply pressure enough to hold and lead the dipper *teeth* into the bank rather than thrust directly forward to force the dipper into it. Don't hoist with the greenhorn shoved in tight against the saddle block.

*Cat belts:* Belts should be kept as loose as possible without losing proper tracking of the driving tumbler. Firm footing permits use of a tighter belt than is advisable in mud or loose earth. When traveling for a distance on pavement or other hard surface, tighten belts to prevent "slapping."

*Drive chain:* A too tight chain wears rapidly, a chain too loose will slap and may result in destructive jerks when load is applied or released. Check adjustments regularly.

1. Be sure oil and grease come to you *clean*.
2. Keep lubricants *covered* and stored neatly in a clean place.
3. Drain oil enclosures *when hot* so the draining oil carries off the sludge.
4. Keep funnels, plugs and oil spouts *clean*. Wipe off oil can covers before removing.
5. Keep *empty* containers that are to be refilled clean and tightly covered.
6. Clean *enclosure covers* before removing for inspection.
7. Clean *outside* of grease-gun before using.
8. Clean *fittings* so that grit is not forced in with grease. When lubricating open or sleeve-type bearings, *wipe off excess grease* forced out of bearing.
9. Be sure gun is thoroughly cleaned before changing type of grease.
10. Keep your machine clean, *always*.

## What Do You Know?--

What do these words mean to you?

### MAGNUSOL METAFFIN D-SCALE-R

They should mean money in your pocket. They are three outstanding Magnus products which do a real job for the user of contracting machinery of all kinds.

Magnusol cleans your equipment quickly, thoroughly and economically without costly equipment and without using a lot of costly elbow-grease.

Metaffin keeps your motors, gasoline or diesel, free of the sludge which causes so many needless repair jobs.

D-Scale-R insures completely clean cooling systems, removing rust, scale and greasy deposits without harm to the cooling system.

If you don't know what they can do for you, it will pay you to write for the Magnus "Fleet Operators Cleaning Handbook"—a complete manual on the cleaning jobs you have to do.

Write for your copy today.

MANGNUS CHEMICAL COMPANY  
113 South Ave. Garwood, N. J.

Service Representatives in All Principal Cities



# MAGNUS CLEANERS

**Operating levers:** Inspect control lines regularly to eliminate lost motion. Keep pins snug. Redrill and put in oversize pins or new bushings when needed. Straighten or replace bent rods. Adjust to distribute control action over full swing of lever but be sure to leave safe release margin.

## Keep Lubricants Clean

Lubricate ropes and drums regularly. Apply a thin layer often so lubricant doesn't drip and splatter in operation.

Be sure to lubricate suspension ropes, even when not moved. They'll rust their strength away if you don't.

Lubricate crawlers whether machine is propelling much or little. Normal digging reactions shift belts back and forth and cause wear.

Keep proper amount of oil in your gear enclosures at all times. Keep dirt and dust out of oil enclosures and containers.

## Lubricate . . . Regularly

Have thorough understanding about who is responsible for lubrication and when lubrication is to be done. Usually the day shift handles and takes responsibility for all periodic lubrication, night shift handles only once-a-shift (or oftener) lubrications and special assignments left in writing by the day shift. Handle lubrication at beginning of shift except any engine crank-case or gear-case oil changes which are best handled at noon when oil is at maximum temperature.

## Prompt Repairs Save Time, Work, Money

Inspect entire machine thoroughly at least once a week. Keep all machinery clean so you can see troubles start. Catch them when they are small and on each structural repair try to add strength to the original unit. Whenever cracks start on castings or structural members, V out and weld promptly before the part breaks through. Apply patches with

slanting or fishtail ends to distribute stresses rather than square ends that concentrate loads and invite breakage of original member on weld line.

Use genuine parts. Cooperate in conservation for war by holding down inventory of repair parts on hand. However, check inventory regularly and try to anticipate requirements 30 to 90 days in advance. Each factory part is made accurately to size and of the correct material correctly treated. A locally made part may give satisfactory service in itself, but may be destroying other and more expensive parts operating in the same assembly.

In reassembly after over-haul, or any repair operation, lock all nuts. Use lock nuts, lock washers, cotters or other devices provided by the manufacturer and secure all your adjustments so they will stay put.

The life of clutch bands, rope, chain, dipper teeth and other parts can often be doubled by reversing to distribute the wear. Check all such parts regularly so that change is made before part is worn away to the point where the reversal cannot be made.

Replace bumpers under shovel boom as soon as wood in armour is largely worn away or splintered out. Dipper should rarely strike the bumper but when it does there should be sufficient timber so that it cannot dent the plate or angles of the boom.

Straighten angles in crane-type boom promptly when bent. Any deflection weakens boom seriously. Use jack and long blocking, heating bent part to cherry red if necessary and sledging to original line and shape. If welded reinforcing is necessary be sure to return structure to original alignment, before putting in the new member or brace. AVOID side loads or bumping of crane-type booms!

Make your machine and every part do the maximum amount of work with minimum wear and breakage. Remember steady safe operation always turns out the best output records.

## Short Moves Often Dig More Dirt

Make short moves often to maintain most efficient digging angle. Never work your bank out to the end of your sticks unless safety requires.

Keep machine working on a solid footing the full length of both cats. If there is a hump dig it out or move around it. Concentrated loads invite trouble.

On long moves watch track-roller bearings and grease all traveling mechanism frequently—small machines need greasing every two miles, large machines more often.

Never leave machine over night or week-end, on a bank or low spot where it might be flooded, or the footing washed from under it, in case of rising stream or heavy rain.

When moving on hills block cats safely before shifting out of gear on all jaw-clutch machines. Take no chances on machine "running-away."

Work shovel with drive chains rear (away from digging), work dragline and dragshovel with drive chains front (towards digging). This is handier for moving and provides more effective braking. It also leaves a tight crawler belt on the ground and the slack "up stairs" where it belongs while digging and moving.

## Warning to Truck Owners

Threats of a serious breakdown in truck and bus transportation facilities within the next three to six months became more real, warns the B. F. Goodrich Company.

For several months applications for new truck tires have necessitated release of about 550,000 units monthly. More certificates were issued the first nine months of 1943 than for all of 1942. Tire production has been falling far short of the number of certificates issued. The industry has been producing truck tires at an all-time record high—but mostly for military or lend-lease. There will be even less truck and bus tires for civilian use each month during the fourth quarter.

It is up to truck owners to make present truck tires last! The best possible insurance that your trucks will continue to operate is a sound tire conservation policy.

Most important factor is correct air pressure. Yet in an analysis of over 300 fleets by B. F. Goodrich tire engineers, not one fleet was using the correct inflation in all tires! Only one fleet out of more than 300 had valve caps on all tires!

For advice, write the Tire Conservation Department, The B. F. Goodrich Company, Akron, Ohio.

# Don't Scrap it - WELD IT

## THE TIME IS NOW!

For speedy, wartime emergency repair welding, you can't beat MANGANAL WELDING PRODUCTS. With MANGANAL you can meet every requirement for efficient, fast, durable repair welding.

Repair your broken and worn parts with Manganal—it's the easy, quick and efficient way. Manganal alloy steel welding, wedge bars and shapes give new lives to old parts.

**STULZ-SICKLES CO.**  
**NEWARK, N.J.**





# Each Operator a Maintenance Man

Notes on an after-Pearl Harbor job in Minnesota muskeg

**O**N-THE-SPOT maintenance has paid dividends to Whitmas & Borg, Bovey, Minnesota, road building team who have built hundreds of miles of new grade throughout the Northwest. The preventive program of this firm is designed to extend the life of all highway equipment, however aged. Each operator is not only skilled in handling his unit, but in its maintenance as well. This firm's viewpoint is that contractors with new or nearly new equipment owe it to themselves and their country to keep their units in good condition. Owners whose machines are over-age or decrepit must resort to all possible mechanical ingenuity, and then "baby" the machines along.

## Notes on the Job

One of the firm's final pre-war Minnesota state road contracts awarded was for a \$204,000 project calling for 8.5 mi. of grading on Trunk Hy. 53 north of Virginia on the International Falls diagonal. With 500,000 cu. yd. of flint-rock, muskeg, clay and sand excavation, this was one of the state's toughest dirt moving jobs.

The work extended over 5 miles of light, sandy soil and 3.5 miles of heavy clay, hard rock and swamp-land. The contract was awarded late in 1941, work started early in 1942, continuing until late in the construction season. Light winter snowfalls permitted movement of their 37 units north in March, and immediately start scrapers along sandy stretches.

Equipment ranged from nearly-new Caterpillar D8s and D7s to veteran trucks and one quite ancient Bucyrus-Erie gas-air 1½-yd. dragline which turned out to be a tough old trooper.

The contract included 550,000 cu. yd. of excavation, 11,000 in hardest rock the contractor had ever worked. During the spring, the contractor moved through sodden hills of sand with two 12-yd. Le Tourneau and one 12-yd. Adams cable-controlled scrapers handling almost all grading and fill. The wet sand loaded easily and compacted in the subgrade without additional watering.

As the spring developed into a rainy summer, the scrapers moved from sand to stubborn, sticky clay—still on schedule, but slowed down from the fast start. Meantime, the



Time-seasoned Whitmas & Borg "super" on this job was F. D. McElwee

battered Bucyrus-Erie dragline swung its 1½-yd. Page bucket tentatively into a suspicious piece of lowland and settled down for a steady stretch of swamp excavation.

## Challenges Alcan Muskeg

You have heard of the muskeg on the Alaskan Highway? You haven't seen anything until you run a new grade through northern Minnesota. At one place the dragline went down through 30 feet of floating bog to find a firm foundation. At another, material which appeared to be wet sand was discovered to have no stability as the dragline almost disappeared in it. It was necessary to build a cofferdam around the machine before a tractor could winch it out.

But the real test to the equipment came on the north end of the contract where 11,000 cu. yd. of rock work lay in road cuts. The rock was flint-like and before it could be loaded, every yard of it was shaken loose by blasting. A Davey 250 compressor with a Cleveland wagon drill pierced the rock for the dynamite charges and then a Lima 1½-yd. shovel loaded out to 18 International and Diamond T trucks. Cuts were not all rock. The deepest was an 85-ft. side-hill cut where Le Tourneau bulldozers on Cat D8 tractors did the dirty work in stripping, with the scrapers moving in for the heavy dirt moving.

## Maintenance Ritual

As work progressed the Whitmas & Borg program of preventive maintenance was in continuous operation. Each of the 30 operators was held fully responsible for maintaining his own machine. There was a carefully prearranged schedule. One service man had as his sole duty the filling of the proper pressure guns and their delivery to the operators. All units



1½-yd. Page bucket swings a load of Minnesota marl

were greased and serviced every 10 hours. Lubrication extended not only to the motors and gears of the machines themselves but, on the cable-controlled equipment and wire ropes.

In their carefully planned program, Whitmas & Borg have followed all manufacturer recommendations to the letter. Just as the treads of the shovels and draglines need lubrication even when not propelling, the cables, even suspension ropes, must be lubricated. Of course, with equipment such as scrapers where cables are constantly subjected to strain and abrasive action, it is doubly important to lubricate the rope after thorough cleansing. Employees were schooled in these precepts.

## Watched Oil Filters

Abrasion is an arch-enemy of construction equipment and Whitmas & Borg have discovered that its destructive action to motors may be reduced by the use of oil filters on the machines. Abrasion also attacks wire rope and, as noted above, may be combated by cleansing and lubricating the cables. The contractors also have preferred preformed wire rope for its high resistance to abrasive action of grit and sand.

In ordinary times whether Whitmas & Borg are on a job or "holed up" for the winter, there is a full time mechanic on the payroll. On a job, it is his duty to operate the completely equipped, portable repair shop that is one of the first units to arrive. During winter months, he was kept busy at headquarters at Bovey, Minn., reconditioning equipment for the coming season. The headquarters repair shop was completely stocked with welding equipment and tools for all full repairs, short of major rebuilding.

(Continued from page 49)

pulled loads up to 60 tons, and to their 150 Studebaker trucks and many FWD's used in conjunction. He recalled one instance where a convoy of overloaded Studebakers inched along 128 miles in 38 hours in compound low gear, finally to run out of gas and stall in a 72-below-zero gale.

Tire chains were worn out wholesale. Trains were winched or snatched over hills, often being broken up for steep climbs. Some slick, hazardous weather was encountered. More than one sled train got out of control and jackknifed into a heap or turned over at the bottom of a hill.

Mechanical troubles there were aplenty, of course. It was a bitter task but when a tractor track went bad there was no alternative than to pull the pins, drag the tractor off, lay the stuff out in the snow and go to work. Welders did considerable work enroute. Fairly well equipped base camps kept busy fixing broken shafts and other parts, building up rollers, etc. The supply line service garage at Peace River had 10 welders all winter. Heavy-duty trailers dragged considerable broken-down equipment into the shop for repairs. However most repairs were done right out in the open beside the road, whatever the weather.

Much trouble was encountered with grousers. Dust grousers snapped in the cold. Standard snow pads would break on striking jagged ice. Notched ice grousers, heavier than snow pads, were the most successful according to superintendent Anderson.

#### Fast Progress in 1943

Late in the winter much equipment had broken down, but all of it was rescued before the thaw. And before the 1943 spring break-up the Army had brought several thousand tons of pipe, marooned from the past summer, across 220 miles of Great Slave Lake from the east and to Fort Norman.

During the 1942-43 winter, also, a supply depot was set up at Dawson Creek at the southern end of the Alaska Highway, also dog team and tractor parties worked toward each other between Fort Norman and Whitehorse, getting camps established for 1943 construction on the pipe line and road between these points. This road was actively pushed under Northwest Service Command and U. S. Engineer direction all through the 1943 season, using methods and equipment similar to those employed on the Alaska Highway. The road, however, is of much lower standard, being only a one-way trail most of the time, with frequent turnouts for passing. The

survey parties met near Sheldon Lake in eastern Yukon in August, and as this was being written the construction crews were hastily clearing trees and throwing down gravel for the maximum mileage of road before winter.

#### County Has Surplus Funds Investment Problem

How to invest surplus funds of more than \$200,000 is a question before the Saginaw, Michigan county road commission. According to county road engineer T. H. MacDonagh, the county's operating reserve is that much over expenses needed this winter, the surplus having been accumu-

lated over the past two years as a result of wartime restrictions on improvements. War bonds are indicated as the answer.

#### Recent "E" Awards

Davey Compressor Co., Kent, Ohio.  
Koehring Co., Milwaukee, Wis.  
Raybestos Division of Raybestos-Manhattan, Inc., Bridgeport, Conn.  
Ransome Machinery Company, Dunellen, New Jersey.  
Foote Co., Inc., Nunda, N. Y.  
LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Ia.  
Independent Pneumatic Tool Co., Aurora, Ill. ("E" White Star).

**DAY and NIGHT...**



**NIGHT and DAY**

Non-stop service under the pressure of events... the tempo of the Buffalo-Springfield roller in wartime.

The building of fields and runways preparatory to attack... the specialized role of the Buffalo-Springfield roller in the drama of war.

Production now earmarked for delivery to the Armed Forces and Military Contractors and available to contractors after Victory.

**THE  
BUFFALO-SPRINGFIELD  
ROLLER COMPANY**  
SPRINGFIELD, OHIO



## New Equipment and Materials

### LaPlant-Choate Airborne Scraper

Developed especially for the U. S. Airborne Aviation Engineers but adaptable to peacetime work is the new Airborne scraper by LaPlant-Choate Manufacturing Co., Cedar Rapids, Iowa.

This unit—the first of its kind ever produced—is a small pocket-size edi-

tion of 1½ yd. struck, 2 yd. heaped, designed for loading into a transport plane or glider. Rear of frame is

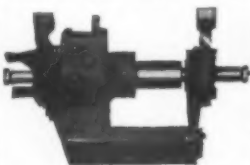


**BUT IN 60 SECONDS IT'LL BE OUT!**

On the job—night and day—are the new Army Crash Trucks, with their asbestos-suited crews.

HERCULES SPLIT-SHAFT POWER TAKE-OFFS, inserted in the drive-shafts of these radically new fire-fighting units, transmit to the pumps the power of the truck motor. The result is a stream with three times the force ordinarily used, and the high-pressure fog thus distributed through the turret guns simply blasts away the flames and smoke.

We're glad that other Hercules products are doing their bit in destroying the enemy, but we're proud to have a part in building a unit which will save the lives of our own men.



Hercules Power Take-off for Truck-mounted Equipment

**HERCULES**  
**STEEL PRODUCTS CO.**

BUILDERS OF HERCULES HYDRAULIC HOISTS AND DUMP BODIES

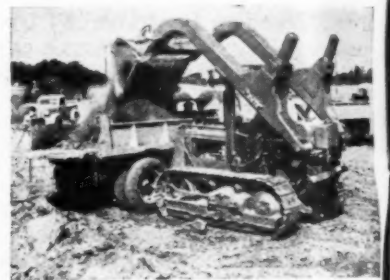
**GALION, OHIO**

so constructed that the rear wheels can be located either inside or outside the cut width.

The scraper is designed for airborne tractors. After the war it will be ideally suited for use with the small Caterpillar D-2 tractor although its size will be increased proportional to the tractor. It will provide an effective tool for landscape work, stripping soil, cleaning and constructing ditches on country roads, etc.

### 'Dozershovel' by Bucyrus-Erie

With a record of extensive service in the armed forces for which it was designed and manufactured, a new two-in-one dirt moving unit—the DOZERSHOVEL for T9 and TD9 International TracTracTors—is announced by Bucyrus-Erie Company. Announcement comes as a result of production in excess of military demands, making limited numbers available for civilian use under government release.



The design provides for full-fledged tractor shovel and bulldozer service. As a shovel, the unit's hydraulic control provides down pressure up to 4200 lb. for real digging "bites" and big pay loads in a short distance of travel. The unit's dumping trip-



mechanism gives the dozer a feature unmatched in other bulldozers: ability to tip the blade forward to release the load on uphill dozing.

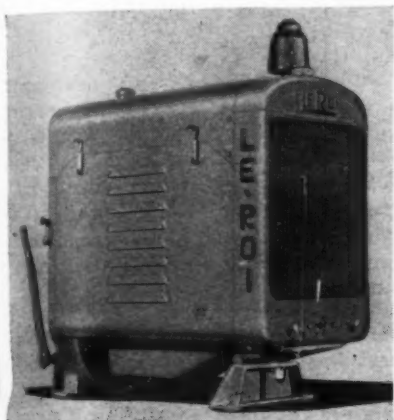
The Dozershovel's visibility without "blind spots" permits accurate dumping and reduces operator fatigue besides increasing the unit's exceptional maneuverability and speed. Its traveling height of only 8 ft. 1½ in. allows it to get in and out of buildings to work in close quarters, to be trans-

ported on trailers eliminating unnecessary route-planning to avoid underpasses.

The standard hook on the upper edge of the shovel bucket or dozer blade, giving the unit a third application; lifting crane service. The changeover itself requires only simple operations. For further details write Bucyrus-Erie Company, South Milwaukee, Wisconsin.

### Le Roi Engine

Le Roi Company has announced a new 4-cyl., valve-in-head engine, the Model D140, newest addition to a comprehensive line. (Other Le Roi units range from 2 to 12 cylinders, 4 to 400 h.p.)



The D140 has a piston displacement of 140 cu. in. and develops up to 33 h.p. at 2400 rpm. The valve-in-head arrangement and wet cylinder sleeves are two of the more important features. They combine to make the D140 efficient to operate and inexpensive to maintain.

A drop forged, counterweighted crankshaft, extra-large main bearings, vertical magneto, drop forged connecting rods, precision bearings, oil bath air cleaner, valve seat inserts, full pressure lubrication, and conveniently located controls, combine with other features to produce an engine of wide applications.

A complete description obtainable from Le Roi Company, 1706 S. 68th Street, Milwaukee 14, Wisconsin. Ask for Bul. 140.

### Moldboard Glaze on Plows

Said to be an aid to snow plowing efficiency is Moldboard Glaze, a liquid which can be sprayed or hushed on the plowing surface. According to the manufacturer it dries in a few minutes at any temperature and leaves a hard, thin coating on the metal which (1) prevents adhesion and freezing of wet snow to the moldboard; (2) reduces friction thus creating savings in power and gas; (3) protects the polished plowing surface

during idle periods. Tests last spring on Army Airports indicated improvement in plowing efficiency, it is claimed, and the material was specified as standard on snow plows purchased by the Corps of Engineers.

Moldboard Glaze was originated and developed by Norman R. Gahnz of the Norgahn Co., Wausau, Wis.

### Steel Grating Test

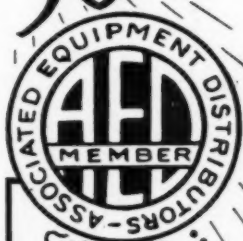
Steel grating such as that used in emergency landing mats for military planes has been installed on a short section of highway in the town of Darien, Connecticut. The test is being made jointly by the town and the

Irving Subway Grating Co. The grid



interstices were sand-filled and given an application of road oil.

## 586 Top-Notch Service Plants for REBUILDING your construction equipment



\*Members in Mexico not indicated in map.

Every spot you see on this map represents a machinery distributing organization with complete facilities for servicing and rebuilding your construction equipment. Many of these companies have branches for additional service.

Each is a member of the ASSOCIATED EQUIPMENT DISTRIBUTORS, an international organization conspicuous in the construction field for its accomplishments. The "A. E. D." symbol you see displayed by these distributors in their advertising, on their letterheads or show windows is your assurance of integrity, square-dealing and reliability.

At each of these distributing headquarters you will find construction equipment engineers, trained and expert mechanics, large stocks of parts and machinery for rebuilding and re-manufacturing war worn machines. You know your equipment is in good hands when it is at an A. E. D. Shop.

### ASSOCIATED EQUIPMENT DISTRIBUTORS

National Press Building, Washington, D. C.

AN INTERNATIONAL ASSOCIATION WITH MORE THAN 500 MEMBERS



# CORONACH

*"Of these immortal dead who  
live again  
In minds made better by their  
presence."*

HARRY C. MERRITT, 62, who retired in 1941 as Vice President of Allis-Chalmers Manufacturing Company and Manager of its Tractor Division,

died November 17 after an extended illness at Macomb, Illinois. He is survived by his widow, and by three children, one of whom, Henry F. Merritt, is Allis-Chalmers branch manager at Peoria, Ill.

Except for a four-year venture into road contracting, Mr. Merritt was identified with the tractor industry until his retirement. He joined Allis-Chalmers in 1923, and in 1926 was appointed Manager of the Tractor Division. In 1937 he became Vice President of the Company, continuing the former post. In 1941, just prior to his retirement, he was

awarded the Cyrus Hall McCormick Medal by the American Society of Agricultural Engineers. The citation read: "For Exceptional and Meritorious Engineering Achievement in Agriculture."



Harry C. Merritt

Since his retirement Mr. Merritt has lived on his farm near Littleton, Schuyler County, Illinois, where he occupied himself with numerous experiments involving the use of modern farm equipment in his farming operations.

BUD H. RADER, vice-president and western manager of Lehigh Portland Cement Company with headquarters at Chicago, died Nov. 6 in his 64th year. Long a leader in affairs of the Portland Cement Association and the cement industry, Mr. Rader had held the post of sales manager at Chicago since 1912.

CLIFFORD OLDER, one of the nation's best known highway engineers, and organizer of the Illinois Division of Highways, died recently at age of 67. Mr. Older was head of the Illinois highway department during the famous Bates Test Road experiment back in the early '20s and at the beginning of the extensive bond issue program on the Illinois state system. He resigned from state work in 1924 and helped organize the consulting firm of Consoer, Older and Quinlan, with which he was identified until 1932 when he resigned to devote full time to inventions and improvements in the highway pavement field.

D. J. SHELTON, President and General Manager of The Marion Steam Shovel Company, Marion, Ohio, passed away on Saturday, November 27. His death was both sudden and unexpected.



D. J. Shelton

Better known as "Doc" to his business associates and friends, Mr. Shelton had held the position with Marion since October 16, 1941, endearing himself to everyone with whom he came in contact. His death will be a severe loss to Marion and to the shovel industry. His was a practical, well sea-

## Air where you want it ...until the job is done!

IT means something for an air compressor to give you air where you want it—from the time the compressor is put on the job until its job is finished.

In SCHRAMM, both compressor and engine are coupled into a single, rigid, permanently aligned unit by means of a sturdy clutch housing which maintains alignment under the severest conditions. Both engine and compressor are watercooled, and there's forced feed lubrication for longer wear, push-button for easy starting. Schramm compressors are designed to match engine speeds, assuring maximum torque and maximum horsepower per gallon of fuel. This is made possible by the use of mechanical intake valves operating from a camshaft in perfect timing with the crankshaft, and piston travel similar to the best automotive design.

For full details, write today for Catalog 42-PA.



**SCHRAMM INC.** THE COMPRESSOR PEOPLE  
**WEST CHESTER**  
**PENNSYLVANIA**



Rapid Fire circulating and steam tank car heater. Designed for heavy duty asphalt heating—not a converted boiler.



Drawn type axle driven sweeper. Available also in motor driven model. Made by

**W. E. GRACE MFG. CO.**

**Dallas, Texas**



Tractor Sweepers—Sweep right or left. Also for sidewalk sweeping, snow removal, docks, platforms.

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**LONGER WEAR,  
LESS MAINTENANCE COST  
because of WELDED  
ROLLED STEEL  
CONSTRUCTION**

• Williams Welded Design means greater strength and eliminates unprofitable "dead" weight.

**MULTIPLE ROPE and POWER ARM  
TYPES • DRAGLINE • POWER WHEEL  
• DREDGING • STEEL MILL BUCKETS**  
¾ to 16½ yd. capacities

Send for free bulletin covering types of buckets for your particular requirements. It shows details of design and many exclusive features that clearly prove why YOUR NEXT BUCKET SHOULD BE A WILLIAMS.

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ENGINEERING COMPANY**  
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**BUILT BY  
WELLMAN**



## MEETINGS AHEAD

Jan. 11-12, Illinois Contractors Assn., Springfield, Ill.

Jan. 13-14, Ohio County Engineers Assn., Columbus, Ohio.

Jan. 17-20, Associated Equipment Distributors, Edgewater Beach Hotel, Chicago, Ill.

Jan. 24-26, Purdue Road School, Purdue University, Lafayette, Ind.

Jan. 25-27, National Sand and Gravel Association, Hotel New Yorker, New York, N. Y.

Jan. 25-27, Wisconsin County Highway Commissioners & Committee Members Assn., Schroeder Hotel, Milwaukee, Wis.

Jan. 26-28, National Ready Mixed Concrete Association, Hotel New Yorker, N. Y.

Jan. 28-29, Illinois Society of Engineers, Champaign-Urbana, Ill.

Feb. 1-3, American Road Builders' Association, Edgewater Beach Hotel, Chicago, Ill.

Feb. 9-10, Southeastern Association of State Highway Officials, Hotel Roanoke, Roanoke, Va.

Feb. 28-29-March 1, Michigan Highway Engineering Conference, Grand Rapids, Mich.

## With the Manufacturers

### Davey Dealer Appointments

Recently announced are the following new franchise dealers for the Davey Compressor Company (compressors, power take-offs, pneumatic saws), Kent, Ohio:

Wentz Equipment Co., 600 N. Van Buren St., Topeka, Kansas. J. L. Wentz, president, is a well known Kansas distributor who has handled scrapers, snow plows, culverts, etc.

Curry Equipment Corporation, 1435 N. 31st St., Philadelphia.

Headed by Glenn M. Curry, this firm will serve eastern Pennsylvania, southern New Jersey, Delaware and adjacent territory.



E. H. Kliebenstein

The E. H. Kliebenstein Company, 856 E. 136th St., New York City. Mr. Kliebenstein was formerly eastern sales manager for Link-Belt.

### Joseph S. Helm On Leave

Joseph S. Helm, for many years manager of the Asphalt Sales Department of The Standard Oil Company of New Jersey, is now on leave of absence, and will retire next April, having completed 34 years of service.

Mr. Helm was one of the original organizers of The Asphalt Association (now Asphalt Institute) in 1918, and has been a Director since its organization, also a former President.

He will make his home at Delray Beach, Florida, and his world-wide circle of friends extend best wishes for full enjoyment of his retirement.

### LeTourneau Offers Film

"Safe Earthmoving," one of the first strip sound films ever dedicated to safe practices in the operation of earthmoving machinery, has been made available for free loan, both domestic and export, by R. G. LeTourneau, Inc., Peoria, Ill. It presents a study of possible earthmoving equipment hazards and visualizes the



BEN-HUR TRAILER ENGINEERING applied to your post-war plans may show you many new uses for handy trailer units—to move tools to the job, to mount vital machine units, carry supplies and materials, or for mobile service units.

Take advantage of Ben-Hur's trailer designing experience. Write for our data sheet to aid your post-war planning.

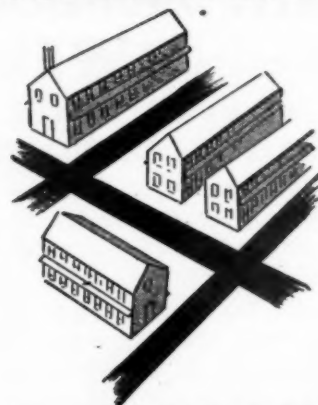


# BEN-HUR INDUSTRIAL TRAILERS

BEN-HUR MANUFACTURING CO.  
434 East Keefe Avenue, Milwaukee 12, Wisconsin

ROADS AND STREETS, December, 1943

## ASPHALT for CANTONMENT STREETS



Various low-cost types of Asphalt construction are ideally suited for cantonment streets where an improved all-weather surface is needed. Asphalt can be easily maintained for as long as it is needed, and can be abandoned at any time without a great investment loss.

Wherever Standard Oil Asphalt products are sold, there is an Asphalt Representative who can give you full information about these and other uses of Asphalt. Write

**STANDARD OIL COMPANY (Indiana)**  
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### TRUCK SHOVELS & CRANES

$\frac{3}{8}$  &  $\frac{1}{2}$  Cu. Yard Shovels

4 & 6 Ton Capacity Cranes

Full Revolving—Low Center of Gravity—Rugged—Flexible—Speedy—Safer.

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Trenchhoe—Shovel

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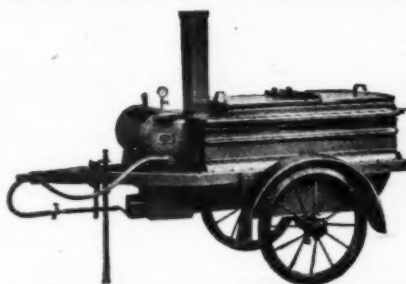
The HANSON CLUTCH & MACHINERY CO.

Phone 417

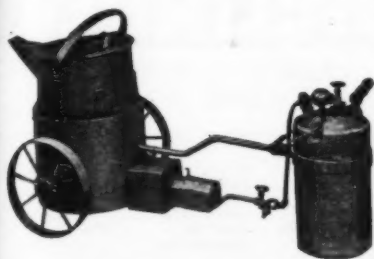
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## CONNER'S HEATING KETTLE

For speedy  
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tar and  
asphalt—



Use this CONNER oil-burning Patrol Patching Heater on the *small* job and this CONNER oil-burning kettle for *large-quantity* production.



Write for catalog showing our full line of tar and asphalt heating kettles, spraying attachments, pouring pots, etc.

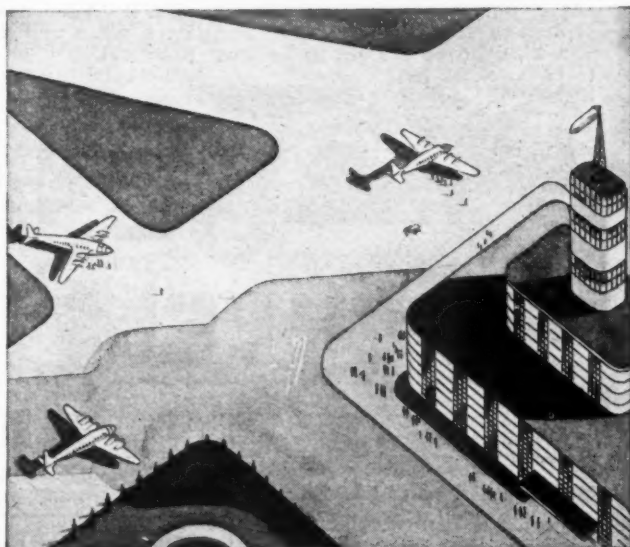
CONNER CONSTRUCTION CO.

3900 North Second St.

Philadelphia, Pa.

## THOSE 'LINERS ON WINGS'

### Where will they land?



LARGER, heavier, faster, the air liners of tomorrow will need bigger airports, with longer landing strips and greater facilities than any we know today. New airports, thousands of them, will spring up all over the world.

Who's going to build them? Why, you contractors, builders, engineers—You fellows who know what it means to move mountains of dirt and lay down concrete by the acre.

What will you use? Well, for one thing, the same dependable St. Paul Hydraulic Hoists and Bodies you know so well. Engineered to the job, they've been "reliable for 30 years."

## St. Paul HYDRAULIC

### HOISTS AND BODIES

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ST. PAUL HYDRAULIC HOIST COMPANY

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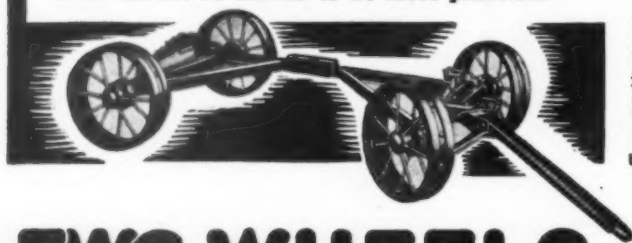
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Let Us Plan EWC WHEELS  
and MOUNTINGS For Your  
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Almost any type of machinery can be made more efficient if it is made portable—with the help of EWC Wheels, Axles, Springs, Tongues, etc. In these fast-moving days, when minutes count, equipment should be mobile to be most practical.



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# EWC WHEELS

ELECTRIC WHEEL CO  
Dept. RS, Quincy, Ill.

## NEED A BIG Trailer?

*La Crosse Makes Them  
Up To 200 Ton Capacity—*

★ WRITE OR WIRE ★

LA CROSSE TRAILER & EQUIPT. CO.  
LA CROSSE, WISCONSIN U. S. A.

## THAW CULVERTS AND HYDRANTS WITH AN AEROIL



### No. 98 Portable Steam Thawer

A handy steam plant with a detachable thawing torch. Used by leading Highway Departments for Culvert Thawing. Special Culvert Nozzle (10 ft.) available. Send for WINTER CATALOG No. 234-S including Concrete Heaters, Portable Coil Water Heaters, Thawing Torches, Ground Thawers, Salamanders, Tar and Asphalt Heaters, etc.

1917-1943—26 YEARS OF SERVICE

AEROIL BURNER CO., INC.  
5711 PARK AVE. WEST NEW YORK, N. J.  
Branches: Chicago, San Francisco, Dallas

## SAUERMAN Long Range MACHINES



### Handle MORE Yards for LESS Money

Many excavating and stockpiling jobs can be simplified by using a SAUERMAN Scraper or Cableway.

These machines dig, haul and dump in one economical straight-line operation and are adaptable to a variety of conditions and requirements.

Because they require but a single operator, consume little power in operation, and are easy to keep in good running order, they cut costs to the bone.

Write for Catalog

SAUERMAN BROS., INC.  
588 S. Clinton St. Chicago 7, Illinois

## BAD GOING? Here's the Truck that eats it up!



If you need a truck for grading, hauling under the worst conditions, snow-removal or similar services you'll find nothing, anywhere, to equal a Marm-Herrington All-Wheel-Drive converted Ford. Prices are surprisingly low, and operating costs a revelation in dollar-savings. Write for literature.

MARMON-HERRINGTON CO., Inc.  
INDIANAPOLIS, INDIANA, U. S. A.

"right" way, with cartoons showing amusing yet serious mishaps. The picture is dedicated to the welfare of the man on the job, to contractors, and all others affiliated with construction. Running time 13 minutes. Fits any projector accommodating a standard 35 mm. strip film and 16-in. record (33 1/3 r.p.m.). Copies may be borrowed free through any LeTourneau dealer.

(Continued from page 88)

soned experience based on 34 years of continuous service to the company he headed, and to his untiring effort are attributed many important developments both in material handling equipment and practices recognized by the industry as a whole today.

Mr. Shelton joined Marion in 1909 after graduating in electrical engineering at Ohio University. His first job was as a shop maintenance man. It was not long however before his engineering talents were discovered and he was made assistant chief engineer, then chief engineer. He then turned to sales, was appointed vice-president in charge of both branches and eventually president.

## Reliance

### CRUSHING, SCREENING and WASHING UNITS

• Up to 2000 Tons a Day •

Crushers	Bin	Drag-Lines
Elevators	Pulverisers	"GAYCO"
Sweepers	Feeders	Centrifugal
Screens	Spreaders	Air Separators
Wash Boxes	Kettles	
	Conveyors	

UNIVERSAL ROAD MACHINERY CO.  
Kingston, N. Y.

Canadian Representatives: F. H. Hopkins & Co., Ltd.  
140 Canada Cement Co., Montreal, Que., Can.

Roy Fruehauf, vice-president, Fruehauf Trailer Company, announces the appointment of Ralph G. Caulley as director of purchases. Mr. Caulley was for ten years with the Republic Steel Corporation as assistant district manager at Detroit.



### Fairbanks-Morse Personnel

O. O. Lewis, formerly Fairbanks-Morse branch manager at Atlanta, has been made assistant general sales manager of the company at Chicago. V. O. Harkness, former manager of the company's Dallas branch, is appointed manager of the Diesel Engine Sales Division, Chicago, being succeeded at Dallas by H. J. Renkin.

J. S. Peterson is now Cincinnati branch manager. G. N. Van Epps, Atlanta manager.

### Euclid Adds Frank Burns

Frank Burns has joined the advertising staff of Euclid Road Machinery, which recently enlarged its department to handle an expansion of future advertising program and plans.

### W. H. Richardson Heads Western Timken Sales

The Timken Roller Bearing Company recently announced the appointment of W. H. Richardson as General Manager of all activities of all divisions of The Timken Roller Bearing Company on the entire West Coast and in the Orient. In this capacity he is to be in complete charge in that territory for the sale and merchandising of roller bearings for original equipment in railroad cars and locomotives, automobiles and trucks, and all types of industrial machinery, as well as the sale and merchandising of bearings for replacement purposes, and will also supervise all sales of Timken Steel and Tubing and Timken Rock Bits.

Previously he was Manager of The Timken Roller Bearing Service and Sales Company, and Vice President of The Timken Roller Bearing Company, Limited, Canada. In 1941 he was made assistant general sales



W. H. Richardson

manager of parent company. He will make his headquarters in San Francisco.

### Joins Thomas Truck & Caster

Ed Histed, formerly with French & Hecht, Inc., is now with Thomas Truck & Caster Co. of Keokuk, Ia. Ed will concentrate his sales effort principally on industrial wheels. The company is adding many new types of wheels to its already very complete line. Ed has had many years of experience with both manufacturers and jobbers in the wheelbarrow and industrial wheel business.

### New Trade Literature

DESIGN MANUAL FOR TECO TIMBER CONNECTOR CONSTRUCTION has been issued by the Timber Engineering Company, of Washington, D. C., the manufacturers of Teco connectors and grooving tools.

The 40-page book offers complete design information, including data on load values, spacings, etc., weights of roof trusses and a table of dimensional properties of American standard-sized lumber. The data are in accordance with the recent WPB national emergency specifications.

"FORM ENGINEERING BY WILLIAMS." A new 66-page catalog of this title by Williams Form Engineering Corp., Box 925 Madison Square Station, Grand Rapids 7, Mich., gives complete information on the economical design of forms, with data on form material cost of clamps per cu. yd. for different types of clamps and methods of spacing. Various ways of securing corners, where form failures commonly occur, are stressed. Also described is hardware and clamp reconditioning taps and dies as well as column clamps and hod guns for grouting holes.

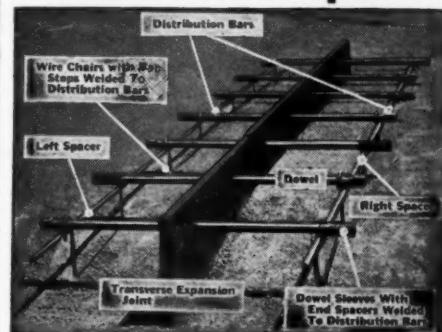
"MAINTENANCE AND CARE OF CLAMSHELL BUCKETS," is the title of a 20-page illustrated booklet by Blaw-Knox Division of Blaw-Knox Company, Pittsburgh, Pa. Contains valuable photos, sketches, and step by step instructions on proper reeving, location of counterweights, lubrication, care of cable, removal and replacement of bearings, renewal of cutting edge, etc. For your copy write the above address for bulletin 1930.

## Build Better Runways

for the Birds of War!

Insure Substantial, Long-Lasting Concrete Runways and Aprons with

## LACLEDE Welded Dowel Spacers

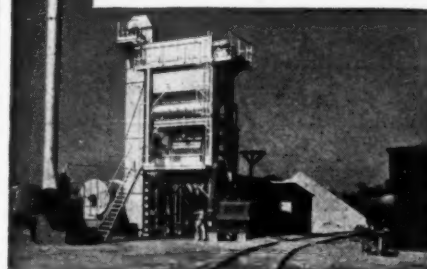


Time-Saving  
Accurate — Rigid  
Available Now!



LACLEDE STEEL COMPANY  
SAINT LOUIS, MISSOURI

### PORTABLE ASPHALT PLANTS High Production—Low Cost



THE McCARTER IRON WORKS, INC.  
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### VULCAN PAVEMENT AND CLAY DIGGING TOOLS

ARE MADE in a complete line of sizes to fit all standard compressed air hammers.

Send for NEW Vulcan illustrated CATALOG today.



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QUINCY, MASS.



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Headquarters for  
**REPAIRS** — any make.  
Factory Service. We will  
also buy your old in-  
struments or take them in trade.

A complete line of Engineering  
Instruments and Equipment for Field  
or Office. Write for Bulletin RS 12.

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Manufacturers of Staring Transits and Levels  
186 N. 12th St. Philadelphia, Penna.

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### IMMEDIATE SHIPMENT

#### FOR SALE:

44C Barber-Greene Ditcher.  
10S Koehring Mixer on 2 Pneumatic  
Tires.  
4" Rex Self Priming Pump—Gasoline  
Power.

#### FOR RENT:

522 Barber-Greene Pneumatic Tired  
Bucket Loader—Gasoline Power.

### PAUL L. MATCHETTE COMPANY

Exclusive Distributors for Barber-Greene Co.

Missouri — Kansas — Oklahoma  
20 West 9th Street, Kansas City, Mo.

## HELP WANTED

**Yard Superintendent or Foreman**—Wanted  
for steady essential employment in small  
asphalt refining and compounding plant.  
No technical knowledge required. Experi-  
ence with pumps and piping, management  
of men, and general knowledge in this field  
desirable. Age 25 to 55, preferably draft  
free. Please write particulars, experience,  
references, salary expected direct to As-  
phalt Refining Division, 2310 West Third  
Street, Cleveland, 13, Ohio.

**Tractor Designer Who "Has Something"**  
is looking for cooperation in development  
of machine for post-war market.

He has in the development stage a trac-  
tor that warrants serious consideration  
from some manufacturer who is shooting  
at big things after the war.

This machine isn't just something that  
looks exciting on paper, but a practical ma-  
chine that has taken a long time and a lot  
of sweat to work out. It's the product of  
a man who has learned the earth moving  
business the hard way, through years as a  
contractor, construction superintendent and  
equipment designer.

A moderate-sized machine. Designed for  
average jobs. Aimed at higher hourly  
work capacity than any machine hereto-  
fore.

Of course we can't tell you all about it  
here, except to say that it is a crawler  
semi-trailer affair, capable of speeds up to  
30 miles per hour with light or no load.  
Has four ground contact points for easy  
maneuverability. Easy on road surfaces  
and bridges. Because of its principle it  
will carry a larger load, or the usual loads  
faster, with a given horsepower.

Your confidential inquiry is invited.  
Box 30, Roads and Streets  
330 South Wells Street, Chicago 6, Ill.

## EQUIPMENT WANTED

### Equipment Wanted

3 yard Diesel Dragline 80 to 100' boom  
2 yard Diesel shovel  
1/2 yard shovel  
Bulldozer  
3-10 ton dump trucks  
Box 51, Roads and Streets  
330 South Wells Street, Chicago 6, Ill.

### Equipment Wanted

All types contractors' equipment; espe-  
cially 75-A and B Lorain shovels, 3/4 yard  
draglines and shovels; 3 ton C H & E rol-  
lers; Euclid dump trucks; Caterpillar front  
end loaders and bulldozers. State age, con-  
dition, serial numbers, lowest cash price.  
Charles M. Ingersoll Company  
Tel. Edison 1010  
19930 Detroit Road Rocky River, Ohio

### For Sale

50 Caterpillar Tractor with Hydraulic bull-  
dozer  
40 Diesel Caterpillar Tractor equipped with  
LeTourneau Angledozer  
RD6 equipped with LeTourneau Angle-  
dozer  
RD7 with double drum hoist  
Cletrac FD 80 with Austin-Western 12 yd.  
Scraper  
Model L Allis-Chalmers with 12 yd. Gar  
Wood Scraper  
TD 18 International with Austin-Western  
8 yd. Scraper  
10-20 International with Trackson Front  
End Loader  
Allis-Chalmers Model K Gar Wood Hy-  
draulic Bulldozer  
2 Austin-Western 77 Motor Patrols, 1 dual,  
1 single tandem drive, hydraulic controls  
1—Adams No. 511 Auto Patrols, Serial No.  
130, tandem dual wheels, new rubber,  
40x8 Diesel Engine, 60 HP, 14' Blade—  
Price: \$4750.00  
Allis-Chalmers Model 54 Motor Patrol  
Jaeger Model 7S Mixer  
P & H Model 150 1/2 yd. Shovel, Serial No.  
4668  
52B Bucyrus-Erie Diesel 2 1/2 yd. Dragline  
75A 1 1/4 yd. Lorain Shovel  
10B Bucyrus-Erie Combination  
40 Lorain Diesel Shovel (1940)  
Byers 1/2 yd. Shovel (1941)  
Page-Walker Diesel 2 1/2 yd. Dragline, 11/2'  
boom  
P & H Model 755 Dragline, Diesel  
3/4 yd. Marion Electric Shovel  
P & H 10-30 Ladder-type Trencher  
Cleveland Pioneer and Baby Trencher  
1 Complete Set of Electric Tunnel Equip-  
ment  
Cedar Rapids Portable Crushing Plant,  
9 x 36 crusher, 16 x 16 rolls, powered D  
13,000 Diesel Caterpillar mounted on  
pneumatic tires  
65-ton Locomotive  
2 American Locomotives, 39 ton and 50 ton,  
side saddle boilers

Ingersoll's Equipment & Supply  
19930 Detroit Road,  
Rocky River 16, Ohio

### FOR SALE

**Pumpcretes**  
13 Rex Models 160, 180, 190, 200, & D201  
Single & Double Gasoline & Elec. Drive  
**Pavers**  
2—27E Ransome Dual Drum.  
27E, 2A Koehring.  
27E Smith.  
27E Multifoots.  
**Asphalt Plants**  
2 Ton Cummer.  
1 Ton McCarter.  
2 Ton H. & B.  
**Road Rollers**  
3-5 & 10 Ton Tandem.  
10 Ton 3 Wheel.  
**Pile Hammers**  
16 McKiernan Terry & Vulcan.  
**Steel Storage Tanks**  
10,000, 15,000 & 20,000 gal. Cap.  
**Tunnel Equipment**  
Conway & Elmcro Loaders, Locomotives,  
Cars, Track, Compressors & Drill Equip-  
ment.

**Shovels—Cranes**  
1 Yd. Osgood Gas Combination Pull Shovel  
& Crane.  
1 Yd. & 2 Yd. Marion Elec. Shovels.  
R. C. STANHOPE, INC.  
60 East 42nd St. New York, N. Y.

### For Sale

1 Keystone Shovel with Ditcher attach-  
ment and Skimmer Scoop, equipped  
with Timken bearings throughout —  
\$1500.00.  
1—10 ton Gas, three wheel Huber Roller  
—\$2000.00.  
1—B-S three wheel five ton gas roller  
—\$1500.00.  
Phil H. McGuire, P.O. Box 34—36th  
Street Station, Norfolk, Va.

### FOR SALE Auto Patrols

- 1 Austin Western 77 Serial D140 dual tan-  
dem, hydraulic; scarifier; snowplow cab;  
starter; rebuilt.
  - 1 Adams No. 5 dual tandem; 14' blade; In-  
ternational Diesel; four new 40x8 tires;  
balance 70% new. Cab. Starter; Scarif-  
ier.
  - 1 Allis-Chalmers Model 54; gasoline; lights;  
starter; scarifier; Serial 6528. Canopy  
top.
  - 1 Model 10 Caterpillar Diesel tandem drive;  
12' blade; lights; bulldozer; hydraulic  
controlled.
  - 1—42A Barber Green bucket loader; com-  
pletely rebuilt.
  - 1—6 cyl. Cletrac with front end loader;  
completely rebuilt.
  - 1—Model 55 Lorain combination crane and  
shovel. Condition excellent.
- Charles M. Ingersoll Company  
19930 Detroit Road,  
Rocky River 16, Ohio

## POSITION WANTED

### Position Wanted

A young or energetic middle aged man  
experienced in Construction Machinery  
Sales, by a responsible Road Machinery  
Manufacturer. Must have ability to direct  
a sales force and handle distributors. If  
interested write Box 50, Roads & Streets,  
330 South Wells St., Chicago 6, Illinois,  
giving qualifications, experience, refer-  
ences, age, draft status and compensation  
expected, in first response.

### Position Wanted

Am open for a position as Supt. or  
Foreman. Have had 25 yrs. of experience  
as Foreman and Supt. on all classes of  
city and highway paving, sewers, levies,  
airports, dams. Can handle labor and  
modern equipment. Am past middle age,  
but capable of getting there. Will go  
anywhere. Dependable and sober. Refer-  
ences.

Box 52, Roads & Streets  
330 South Wells Street, Chicago 6, Ill.

**Position Wanted — Superintendent.** Have  
35 years' experience supervising and build-  
ing all phases of Federal, State, Cities and  
Counties Projects, Airports, Highways,  
Bridges, Viaducts, Interceptor Sewers,  
Water Lines, Foundations and Flood Walls,  
Heavy and Light Excavating. Familiar  
with all Government Project Construction.  
Qualification Unquestionable. Organizer  
and Estimator. Knows Cost. Age 53 years.  
Best of References. Address Box No. 25,  
Roads and Streets, 330 So. Wells St., Chi-  
cago 6, Ill.

(Continued from page 72)

sale to cities, counties and other local agencies. Heavy equipment should be offered to the states first, he quotes, but not on a basis that will make for unfair force-account competition with contractors. The subject was referred to the Maintenance and Equipment Committee, R. H. Baldock (Ore.), Chairman.

**Equipment Problems.** In the Maintenance and Equipment session B. R. Downey (Mich.) on "Equipment Problems in Wartime," told how Michigan has established a priority department at Lansing to expedite the purchase of equipment. He stressed greater attention to the commonplace things in preventive maintenance, such as checking of cooling, battery, starters, etc. Especially this time of year watch any lowering of the level of the cooling liquid. Also not to be forgotten are the safety practices, a review of which is specially important in training new men.

**Road Construction.** The Road Construction session included a review of suggested changes in concrete highway specifications. Minor changes and a suggested specification on ready-mix, were presented by the subcommittee on concrete road construction.

Much interest centered in a symposium on the effect of post-war conditions on highway practice. Several state leaders gave zone reports based on questionnaires. E. L. Roettiger, state highway engineer of Wisconsin, prophesied a high price level and high labor costs. He warned that while large equipment units will be in demand, even the biggest construction boom is made up also of many small projects needing smaller equipment.

J. J. Corbett, engineer of construction, Missouri, on the possibility of an equipment shortage, said that manufacturers report plenty of equipment capacity. In some plants reconversion is a "20-minute job . . . just change from G.I. paint." He looked for more crawler units, greater strength with less weight in equipment designs, greater capacity and lower unit costs, with possibly finis to the 27 E paver on big jobs. On the other hand the huge cantonment and airfield program has not revealed any new construction methods or materials, due to speed and freezing of technology. But changes will surely begin to come after retooling, such as more plywood in culverts, harnessing of electronics in steel fabrication, walkie-talkie contact between field and office, etc.

There'll be more soil surveys, soil correction.

Labor costs will determine prices,

as in other periods. War-time habit of speed will carry over to some extent. Returning war-trained engineers will bring a fresh point of view, fresh resourcefulness. Big construction volumes such as post-war planners are counting on may limit competitive bidding, but better management and labor relations will help reduce unit costs. Question: Why cannot the contractor's or engineer's "relations" be enlarged to take in the "owner"—the public? Greater thought should be given by all organizations to present constructive information to civic groups and the press.

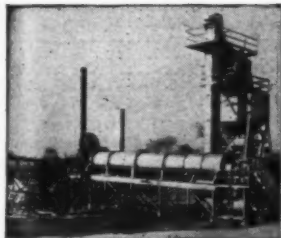
Public relations will be needed as never before in selling and keeping sold such sound principles as the contract system, and help fight a possible return to WPA.

Finally, it is imperative that state highway departments find a way to speed up post-war plans and surveys in spite of engineer shortage, by stepping up working hours. Warning: don't develop a large volume of partially ready projects.

Daniel Starr, substituting for C. H. Bushell, Connecticut, sees bigger use of air-entraining cement and admixtures. He noted that a time when fewest changes in methods are in sight is when the most changes may be brewing.

## Asphalt Mixing Plants

STATIONARY and PORTABLE



★ Hetherington & Berner asphalt mixing plants, products of the pioneer builder of asphalt machinery in America, incorporate the latest features of design which have been proved in performance. Specifications conform to the most rigid state and city requirements, both as to engineering design and safety regulations. Write for Bulletin RS-260.

Hetherington & Berner Inc.  
Indianapolis, Indiana

America's First  
Builders of Asphalt  
Paving Machinery

*Hetherington  
& Berner*



## SILVER KING

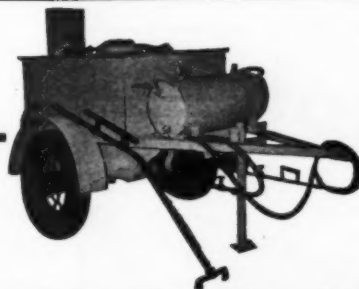
HIGHWAY MOWER



• Watch out for those minor damages that might put your highway mower out of action for the duration. A little extra care prevents extra wear and repair!

If you own a Silver King, you'll see, more than ever, what it means to have a mowing unit ENGINEERED for the job. If you want replacement parts now to insure tip-top "good-as-new" performance tomorrow, write. We will be glad to serve you.

MANUFACTURED BY  
**THE FATE-ROOT-HEATH CO.**  
PLYMOUTH, OHIO



## ASPHALT and TAR KETTLES

FIRE PROOF—OIL BURNING  
Hand and Motor driven spray.  
Many sizes. Write for catalog.

Elkhart White Mfg. Co. Indiana

Round and Round  
It Goes  
It's Good  
Everybody Knows

**"FLEX-PLANE"**

FLEXIBLE ROAD JOINT MACHINE CO.  
WARREN, OHIO, U. S. A.





## ALL OUT FOR THE WAR EFFORT AND VICTORY!

BUT FULLY PREPARED TO  
MEET YOUR POST WAR PLANS

★ In Trojan equipment you will have machines that will make "after victory" contracts more successful. We are looking forward to the post war era when we can again take care of your normal requirements.

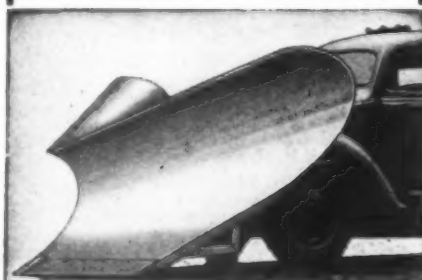
Trojan equipment includes GRADE RIPPERS—TAMPING ROLLERS—SHOULDER EXCAVATORS—SCRAPERS—MAINTAINERS—GRADERS—SNOW FLOWS



**CONTRACTORS MACHINERY  
COMPANY, Inc.**

BATAVIA, NEW YORK, U. S. A.

# Root



Root V-type and Oneway Truck Snow Plows have helped to keep war industries, Army Camps and Airports open and will continue to do so.

Root has enlisted for the duration and is now running 100% for Victory.

## ROOT SPRING SCRAPER CO.

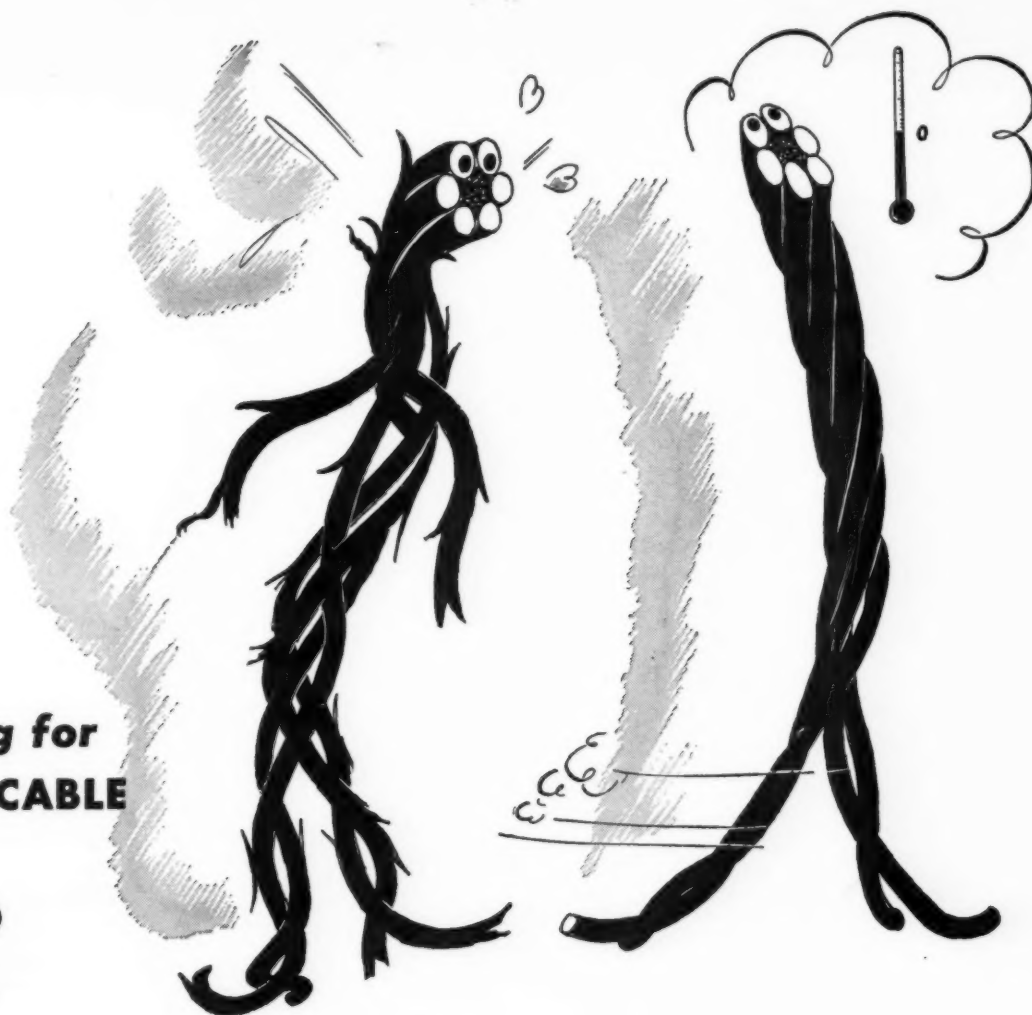
Kalamazoo, Michigan

Builders of Truck Maintenance  
Equipment for more than 30 Yrs.

# Index to Advertisers

A		K	
*Adams Company, J. D.....	Second Cover	Koehring Company .....	35
*Aeroll Burner Co., Inc.....	92	L	
Allied Steel Products, Inc.....	26	*Laclede Steel Co.....	93
Allis-Chalmers Tractor Division.....	15	*La Crosse Trailer & Equipment Co..	92
American Cable Division.....	Third Cover	Lewis Equipment Co., H. W.....	32
American Chain & Cable Co., Inc.....	Third Cover	*Littleford Bros.....	20
Associated Equipment Distributors..	87	M	
Auto Gear & Parts Co.....	60	Magnus Chemical Co.....	82
B		MacMillan Petroleum Co.....	10
*Baker Manufacturing Co., The.....	9	Marion Steam Shovel Co., The.....	33
*Barber Greene Co.....	7	*Marmon-Herrington Company, Inc....	92
Ben-Hur Mfg. Co.....	90	Matchett Co., Paul L.....	94
*Bethlehem Steel Company.....	1	McCarter Iron Works, Inc.....	93
Blackhawk Mfg. Co.....	18	*Michigan Power Shovel Co.....	36
Briggs & Stratton Corp.....	26	O	
Bros Boiler & Mfg. Co., Wm.....	37	*Osgood Company, The.....	17
*Buckeye Traction Ditcher Co.....	23	*Owen Bucket Co., The.....	21
Bucyrus-Erie Co.....	5-33	P	
Buffalo-Springfield Roller Co.....	85	*Pioneer Engineering Works.....	25
*Burch Corp.....	26	Preformed Wire Rope.....	21
Byers Machine Co., The.....	32	R	
C		Rogers Brothers Corporation.....	30
Calcium Chloride Ass'n.....	67	Root Spring Scraper Co.....	96
Chicago Pneumatic Tool Co.....	4	S	
*Cleveland Tractor Co., The.....	40	*Sauerman Bros., Inc.....	92
Connery Construction Co.....	91	Schramm, Inc.....	83
Contractors Machy. Co., Inc.....	96	Sisakraft Co.....	27
E		Standard Oil, Calif.....	74
Electric Wheel Co.....	92	Standard Oil Co. (Indiana).....	90
F		St. Paul Hydraulic Hoist Co.....	91
Fate-Root-Heath Co., The.....	95	Stulz-Sickles Co.....	81
Fawick Airflex Co., Inc.....	29	T	
*Flexible Road Joint Machine Co.....	95	*Texas Co., The.....	Back Cover
Flink Co., The.....	32	Thew Shovel Co., The.....	1
Foot Company, Inc., The.....	34	Timken Roller Bearing Co., Front Cover	
*Four Wheel Drive Auto Co.....	19	Timber Engineering Company, Inc....	60
G		Tuthill Spring Co.....	20
*Gallon Iron Works & Mfg. Co., The..	13	U	
*General Excavator Company.....	17	*Universal Engr. Co.....	8
Grace Mfg. Co., W. E.....	89	Universal Road Machinery Co.....	92
*Gruendler Crusher & Pulverizer Co..	6	Universal Atlas Cement Co.....	22
H		V	
Hanson Clutch & Mach. Co.....	91	Vulcan Tool Mfg. Co.....	93
Hercules Powder Co.....	14	W	
*Hercules Co.....	17	Wallace Tire Service, Inc.....	94
Hercules Steel Products Co.....	86	Walter Motor Truck Co.....	12
Hetherington & Berner, Inc.....	95	Ward, La France Truck Division....	16
Hough Co., Frank, The.....	11	(Great American Industries, Inc.)..	94
*Huber Mfg. Co.....	28	Warren-Knight Co.....	89
I		*Wellman Engineering Co., The.....	95
*International Harvester Co.....	21	White Mfg. Co.....	30
*Iowa Mfg. Co.....	39	*Wisconsin Motor Mfg. Co.....	31
J		Wood Mfg. Co.....	31
*Jahn Co., C. R.....	32	*Advertisers with * are represented in the 1943 edition of Powers' Road and Street Catalog and Data Book. Please refer to it for additional information on any of their products.	
*Jaeger Machine Co., The.....	81		

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